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RAILROAD ISSUE

Railroad Relocation and Reconstruction Near New York Barge Canal

By B. S. Voorhees, District Engineer, New York Central R.R.

New Engine Terminal for Lehigh Valley R.R.

Rebuilding Poughkeepsie Bridge

By C. E. Chase, Resident Engineer with Ralph Modjeski, New York

Shallow Pit Coaling Station for C. & O. R.R.

Twenty Years of Reinforced-Concrete Ties

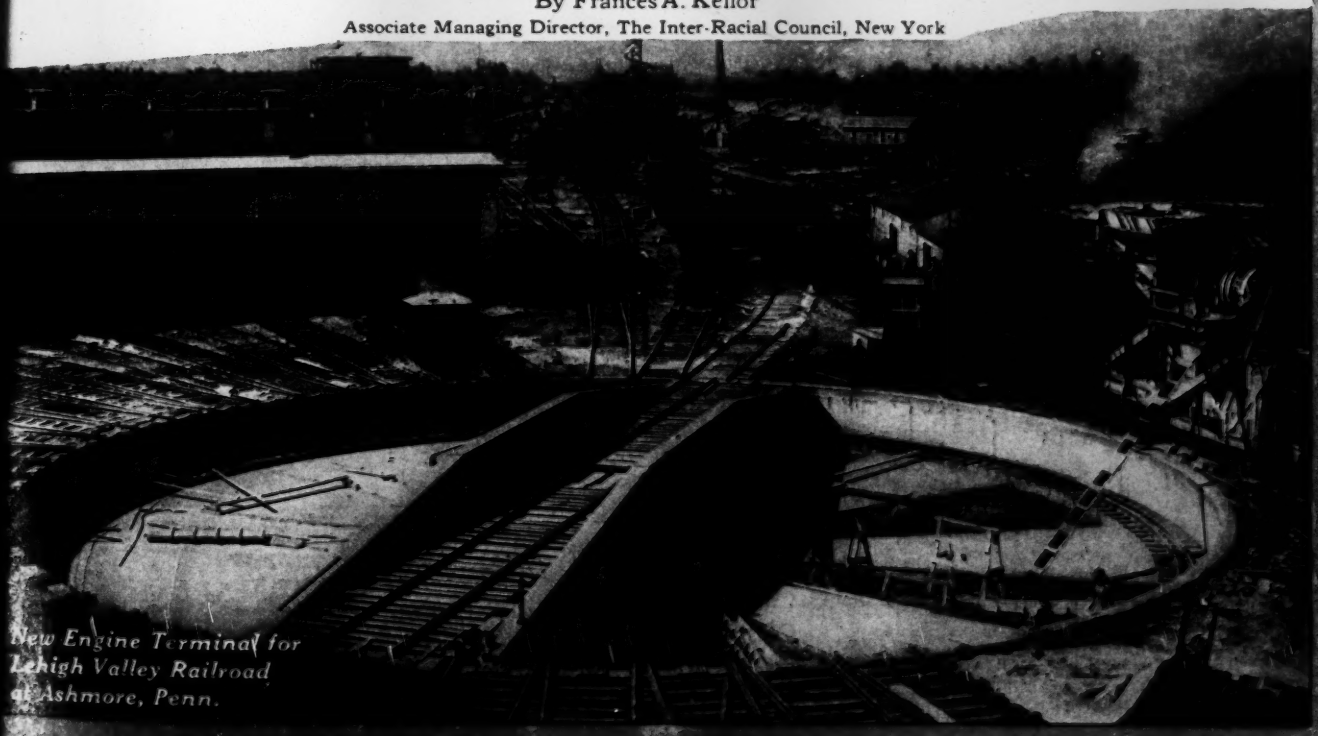
By C. H. Wakefield, Office of Consulting Engineer, Southern Pacific Co.

Special Article:

A Leaf from Lenin's Policy on Man-Power

By Frances A. Kellor

Associate Managing Director, The Inter-Racial Council, New York



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E. J. Mehren
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An Issue for Transportation Engineers

FOLLOWING almost on the heels of the event which marks a new epoch in railway administration—the return of the carriers from Government to private control—this year's annual convention of the American Railway Engineering Association, which opens in Chicago next week, is one to which more than the usual significance will attach. The pall of despondency which has stifled initiative in matters of transportation for the past year or so has been lifted and new hopes have been born. The changed conditions induce progressive thinking. Much must be done and railway engineers, relieved from the monotony of marking time, are now looking forward to a period of action. At such a time the experiences of others can be studied with more than ordinary profit and it is for this reason that a large amount of space in this issue has been devoted to the problems of the transportation engineer. Mr. Voorhees tells of the railway reconstruction necessitated by the building of New York's Barge Canal while Mr. Chase describes how the Poughkeepsie bridge has been enlarged and strengthened for the second time to meet the demands of heavy traffic. Other subjects, less spectacular, perhaps, but equally important, are dealt with. Among them are an analysis of 20 years' experience with concrete ties and a new engine terminal and coaling station, designed to meet special conditions. The railway engineer of today cannot afford to neglect the development which is taking place in the field of highway transport. There have been included in this issue, therefore, articles relating to highway traffic both in England and in the United States, and the transfer of local freight by motor truck as an aid in the solution of a terminal problem in Cincinnati. To the man with eyes to see the experiences of others are always valuable, for they can be used sometimes directly or sometimes in modified form on his own work; they may suggest new and better ways of doing things. In the railway field there is now promise that initiative and effort will not be without their rewards.

Bridge Loadings and Poughkeepsie Reconstruction

IT IS well worth while for railway bridge engineers who insist on providing for nothing beyond loads actually in sight to reflect on the history of the Poughkeepsie bridge, with its two elaborate reconstructions within thirty-five years. The money spent in strengthening and rearranging this structure to enable heavier engines to cross it in safety would have warranted a largely increased original expenditure for a stronger bridge than seemed necessary at that time. And the losses and indirect cost of traffic interferences, and other results of having to operate an inadequate bridge, also need to be considered. However, it has ever been a prime article of faith in railway circles that traffic loadings would not increase much, if at all, and that in consequence no expenditure would be justified in providing for load increases that seem perhaps remotely possible but certainly not probable. Decade after decade the facts have proved this view wrong, and so our railway bridge history has been a continuous record of bridges outgrown by the traffic being either scrapped or, very rarely, reinforced. With this record in mind, may we not fairly conclude that bridges of today should be designed for loads well beyond those now in existence? Railway engineers are still as reluctant as in past decades to make provision for future increase of weights, and they are about to adopt a new specification establishing as standard a loading already equaled and in a few cases somewhat exceeded. The lesson of fifty years' railway history suggests strongly that this reluctant attitude may be worth modifying. Better support of the bridge department by executive and financial officials of the railway would help to bring this about.

Originality in Reinforcement Work

SOME weeks ago we suggested in these columns that reinforcement of bridges makes a call on the best ingenuity and skill of the structural engineer. Two features of the Poughkeepsie work are very much to the point in this respect: the rigid-floorbeam method of making the three trusses of the river spans co-operate at full efficiency in carrying the load of a single track, and the use of heating to compel the tensile reinforcing material to share in the dead-load stress. As to the former, it will be enough to say that the choice of this method evoked active technical discussion before contracts were let and work started. The compelling logic of making the three trusses work at the same unit-stress by subjecting them to equal deflection through the means of a stiff continuous floorbeam won the day, however, and subsequent stress measurements gave a check on the working success of the method. Its great simplicity increases rather than diminishes the credit due the engineer. Equal simplicity and effectiveness is apparent in the expedient of riveting the reinforcing material in place while stretched by slight heating, a method that promises to be applicable in much future work. The resourcefulness involved in devising and successfully executing such special expedients is hardly matched by the kind of thinking that has to be done in building a new bridge. With the growth of reinforcement operations that may be expected, structural originality and ingenuity will therefore be even more needed than heretofore.

The Steel Decision

IT MAY be rash for the non-legal mind to attempt a comment within the compass of a few sentences on the decision of the Supreme Court in the Steel Corporation case. To us the decision is but confirmatory of the general view that has run through previous trust decisions—that corporations are criminals not because of mere size, but because that size has been used to make effective restraints of trade or practices that have

worked adversely to the public. In other words, the potentiality of wrong doing does not make a corporation criminal. This certainly is a logical rule. If size were to be made the criterion of legitimacy, the course we have been pursuing in integrating industries would have to be abandoned.

Hetch Hetchy Delay Threatened

WORK on the Hetch Hetchy project, which is to provide San Francisco with a mountain water supply, will have to be suspended, according to City Engineer O'Shaughnessy, unless more Hetch Hetchy bonds can be sold. The work has in fact been going on for several years on a narrow margin financially, and from year to year there has been barely sufficient money to keep the work in progress on an economical basis. Counting this as one of the many difficulties that have attended this work, the city's engineering department has for a long time made every effort to sell enough of the bonds to keep going. The plan of selling them to the contractor at par, allowing him to absorb the discount in his bid, has been the most successful plan, and this seems to be the only salvation in the present crisis. At least it would avoid the closing down of the work with the attendant loss of the organization—a very serious thing in these days—and would prevent delaying the date of completion. Continued progress is desirable, not only to provide San Francisco with an unsurpassed water supply, but because a portion of the associated power project could soon be completed so the city could begin to realize on its investment.

Power Unification and Power Retailing

A PROPOSAL discussed by the American Institute of Electrical Engineers recently contemplates the virtual consolidation of all power generation in a great area extending from Boston to Washington, by means of a high-voltage tie line to connect all power stations in that area. If carried out, the scheme would bring into being a gigantic power source exceeding anything we now have; it would have influence over a remarkably great number of people, and stand in a vital relation to their physical existence. That so large and complex an enterprise should also engage in retail distribution of electric current is hard to conceive or to recognize as commercially desirable. In fact, it seems quite likely that so soon as such a huge, distributed power source is created, there would come about a complete separation of the business of distributing and selling electric power from that of generating and transmitting. How would the business be divided? In the event that the present electrical interests retain the generating business, it might perhaps become necessary for municipalities themselves to conduct the intramural service of distribution and sale, as they do now in the case of water. With this in mind, municipal engineers should find the tie-line proposal worthy of their study. True, for the present the consummation of the project is still in the vague distance, the more so because of the federal Department of Interior's undertaking to promote it by a Congressional appropriation for study of the situation. Coming at a time when Congress is of necessity paring down departmental demands, and in view of the uncertainty as to how a sum of a quarter million would be applied to such an investigation, the matter is rather far in the speculative future.

Terminal Congestion and Motor Transfer

CONFRONTED with problems of terminal congestion, railroad engineers will be interested in the article on p. 508, describing the less-than-carload transfers system in use at Cincinnati. A perplexing problem is, apparently, under way toward solution by using motor trucks with demountable bodies in conjunction with existing facilities. The motor truck is being used not to compete with but to supplement railroad facilities and to bring out their greater usefulness.

Briefly, it was the purpose to effect a more rapid interline and substation movement of less-than-carload freight, at the same time practically eliminating the use of station transfer or "trap" cars, and reducing the movement of interline cars. Through the substitution of an efficient system of motor trucking and mechanical handling of demountable bodies, this purpose appears to have been accomplished. It might seem that the greatest economies would accrue from interline transfer, but it is significent that the first installation was for a single railroad to connect its main and substations.

Possibilities for economy by efficient motor transfer, through increasing the utility of existing facilities, may serve as a basis for many future traffic studies. For most large industrial centers, such a system suggests greater flexibility of freight handling through an increase in car capacity and effective track and platform capacity. The release of cars from transfer to main line service speaks for itself in the present shortage. An increase of one-fifth in effective track capacity, as reported at Cincinnati, gives promise of relieving congestion of storage and classification trackage. The decrease, by one-half, of necessary station platform space is a measure of the greater concentration of loading and speed of handling possible with more efficient mechanical equipment.

Recollection of the industrial expansion of a typical American city is important in considering the possible advantages to shippers. Railroads first concentrated their main freight stations at the industrial center and as industries were obliged to locate in outlying districts, substations were established to afford better shipping service. As this expansion progressed, it was naturally accompanied by an increasing demand for interline and station transfer, with the necessity, in most cases, of consolidating shipments at the old main stations. Now the possibility of establishing mechanically operated motor-transfer stations without rail connection is suggested to permit industrial expansion with less regard to location on railroad lines. With an efficient system of handling and dispatching, as installed at Cincinnati, this suggestion gives promise of success. The shipper may locate on cheap property and reduce his own truck hauls—or eliminate them by installing a substation at his own plant to be served by trucks of the centralized system. Similarly it is suggested that the electric interurban lines could be better adapted for short haul business by establishing substation service, with some such arrangement as that shown in the photograph of the Baltimore & Ohio station at Norwood. In any such development on a large scale, the layout should be made by engineers, with careful consideration of possible future traffic congestion of city streets.

To the engineer naturally accustomed to thinking in terms of railroad units, the transfer of freight by motor truck on a large scale may seem so revolutionary

as to be generally impracticable. At many other centers conditions probably would not warrant such radical treatment, but the results so far obtained should be carefully considered by railroad engineers charged with the responsibility for relieving similar conditions and of planning future terminal development.

New Rate Rule Not a Guarantee

SO MANY misstatements are being made regarding the rate rule of the new Interstate Commerce law that there is widespread belief that it guarantees a fixed return to the carriers. Such is not the case. The law merely sets up a basis of ratemaking designed to bring a fair return to the roads of average earning capacity.

Consider, for example, three systems in the same rate group: A prosperous line which, through strategic position, is capable of earning a far greater return, with the same rates, than most of the other lines in the rate district; a poorly located line, which can barely meet the interest on legitimate bond issues, and an average line which, with fair rates, can earn only a reasonable return on its investment. Under the terms of the law the rates are to be fixed to produce, as nearly as may be, a definitely stated rate of return on the aggregate value of all the lines in the rate group. When rates are so fixed, the "poor" road will have difficulty, even with economy and skilful management, to pay dividends approaching anything like the supposedly fixed rate of return. It will probably earn considerably less. The "average" road, if the mandate of the law is successfully carried out, should earn the so-called fixed return. The prosperous road, unless it is mismanaged and the accounts manipulated, should earn more than the fixed rate, but one-half of the "excess" above 6 per cent must be paid to the Interstate Commerce Commission.

The effect of the valuation of a single road on its income will not be great except in the case of prosperous systems. Large value placed on the property of the poor road will affect its earning power, through rates, only as it increases the aggregate value of all properties in the rate district. Only in exceptional cases will the effect be appreciable. Practically the same may be said of the average road. But the effect of the valuation placed on the property of the prosperous road may be pronounced, since its earnings are limited only above a fixed percentage of its "value." It is conceivable to imagine such a system being allowed a sufficiently high value, based on income producing qualities, to nullify the effect of limiting earnings above a fixed percentage of ascribed value. In this event all other companies in the district would also benefit in earning power, but only in proportion to the effect of the prosperous road's value on the aggregate of all.

In the uses made of the transportation contingency fund to be administered by the commission—and the fund may become large—the effect on individual earning capacity can at best be a matter of conjecture at this time. But it is likely that the building up and judicious expenditure of such a fund will tend ultimately to reduce unit costs of transportation by providing additional facilities for more traffic without greatly increased charges for capital.

Of greatest importance for the present is the probable effect of the rate rule in attracting private capital into railroad development. This development must necessarily take place slowly. So much lies in the hands of the Interstate Commerce Commission that its attitude will largely determine the course of private investors. In the present state of the market a 7½ per cent return will be no great inducement. But with assurance of a definite basis of ratemaking, much development held in abeyance should go forward with promise of returns more than enough barely to justify the investment.

In spite of the statements that have been made by parties at interest, the new rate rule does not embody a guarantee of earnings. While the law recognizes the principle of finance for security and interest, rather than finance for profit, it does not provide a subsidy for unfortunate investment.

Status of the Reinforced-Concrete Tie

WILL the reinforced-concrete tie become a practical substitute for the wood tie? This question will occur to every reader of the review of concrete ties and their service on p. 522. The review indicates many failures but it may well be that after passing through a stage of haphazard design and trial the concrete tie now presents an opportunity for engineering skill in design. Further large-scale trials are warranted.

Few of the thirty-five designs, representing some 20,000 ties which have been given trial, are based on scientific principles and many trials have been made in numbers insufficient to warrant definite conclusions, except in cases of complete failure. While the tests reported were made under various conditions (some of them not exactly), it is of interest to note that the Tie Committee of the American Railway Engineering Association, in 1912, reported that no single design of substitute tie, whether of steel or of concrete, can be expected to meet all conditions, and recommended that there be at least two types, one for heavy and one for light service. It appears that much experimental work was inconclusive because of inadequate traffic records.

Fracture under load, disintegration of concrete and destruction of bond between the concrete and steel are the principal types of failure that have been noted. Of these, the second appears to be the least serious, since good concrete has withstood vibration and shocks of track service better than might be expected. The two types which are commended in the review are not the reinforced-concrete beam type, but rather that consisting of two rail-bearing blocks connected by a light member. Further development in design to resist failure may well be founded on work of the joint A. R. E. A. and A. S. C. E. committee on stresses in railroad track, abstracted at length in *Engineering News-Record* of Feb. 26, 1920.

To compete with the wood tie—especially with the treated tie—the concrete tie must compare favorably in true annual cost and also in other practical respects, as maintenance and rail attachments. Little data on initial costs are available because the experimental ties have not been produced on a commercial and competitive basis. Figures of life are not conclusive, owing to the small number given trial and relatively short service. The handling of concrete ties may demand special attention, owing to their relatively great weight.

It appears that further development might well follow along the two independent lines of heavy and of light service and that trials should be undertaken with more accurate observation, more definite objective and a broader consideration of engineering principles.

New York Central Railroad Accommodates Itself to Construction of Barge Canal

Contiguity of New State Waterway With Chief Rail Route Necessitated New Bridges, Rebuilding of Crossings and Relocations—Construction Details—Negotiations With the State

By B. S. Voorhees
District Engineer, New York Central Railroad
(Formerly Engineer of Grade and Barge Canal Crossings)

When the New York Central R. R. turns traffic over the new bascule bridge across the westerly terminus of the New York State Barge Canal, at Tonawanda, N. Y., and removes its old bridge, as it expects to do this spring, the program of accommodating itself to the construction of the canal will be complete, with the exception of legal settlements. The completion of the Barge Canal as a great public enterprise, at a cost of $154,000,000, is a remarkable engineering achievement with its movable dams, locks, steel guard gates and reservoir dams. But prominence should be given the solution of the engineering problems created by building the canal, which were necessary to preserve the railroads adjacent to it. The work involved the construction and alteration of 38 railroad bridges and the relocation of four portions of railroad alignments; of the former 24, and of the latter 3, were on the New York Central R.R. Other effects of the Barge Canal construction on the railroads were the necessary appropriation of railroad property, elimination of certain grade crossings and abandonment of old structures. It is the purpose of this article to record the reconstruction work which the railroad had to carry out as the result of the construction of the Barge Canal as well as its other effects on the railroads.

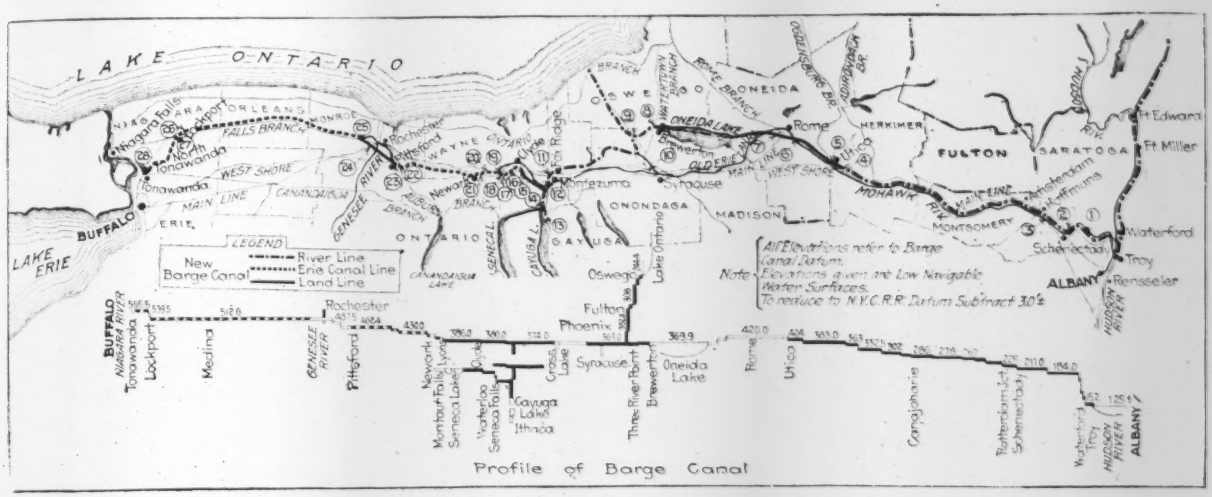
There has been considerable speculation as to the usefulness of the canal and justification of the tremendous expenditure involved in its construction. On account of their greater speed of transportation and flexibility, railroads have to a large extent overcome the competition of canals, as between the canals of New York State and the railroads which parallel them. But it is not too much to hope for a new era in transportation when the United States will have felt the full effect of a great industrial development that will require both means of transport.

The problem between the New York Central R.R. and the canal lies in their geographic locations, both having sought to share not only the most economical routes through the natural valleys of the State, but also the direct path of dense traffic movement forming the great highway of commerce between the central part of the United States and the sea. Before considering in detail the problems involved, a glance at the history of the two routes is interesting.

Before the advent of either canals or railways commerce was carried on over substantially the same route, along the rivers and lakes, with three wagon carries between New York and the Great Lakes. The building of three portions of canal, in about 1800, to handle the old land carries, was followed in 1817 by the beginning of the Erie Canal which was opened in 1825 for 75-ton boats of 4-ft. depth and a bottom width of 28 ft. Since then the canal has undergone two enlargements, previous to the Barge Canal development, which was commenced in 1903, to provide for boats of 2,000 tons with a depth of 12 ft. and a bottom width of 75 ft.

The first railroad in New York State, and the second in operation in the United States, was the Mohawk & Hudson—now a part of the New York Central—chartered in 1826 and opened from Albany to Schenectady in 1831. It is significant that the six-ton locomotive first operated on this line was named the "De Witt Clinton" after the Governor of the State, who was the master spirit of the Erie Canal. From this small beginning grew the New York Central R.R. System. But difficulties were encountered from fear of the State that the railroad would become a dangerous competitor of the canal and in 1831 the Legislature refused to grant a charter for a railroad from Schenectady to Buffalo. When the line was extended to Utica, in 1836, it was not allowed to carry anything but passengers and their ordinary baggage. A road was opened from Rochester to Batavia in 1837; one from Utica to Syracuse in 1839; from Auburn to Rochester in 1841; from Batavia to Buffalo in 1842, and in 1843 all gaps were closed to com-

NEW CROSSING WORK UNDER WAY AT FOX RIDGE. TRAFFIC IS DETOURED DURING CONSTRUCTION



MAP OF BARGE CANAL SHOWING NEW YORK CENTRAL CROSSINGS

plete a line from Albany to Buffalo. In 1853 the ten separate companies consolidated into one corporation under the name of the "New York Central Railroad." Thirteen years later this road was merged with the Hudson River R.R. In 1881 a consolidation of several lines was completed to form the West Shore R.R., which six years later was leased by the New York Central. While the waterway grew in size from a capacity for 17-ton to 2,000-ton boats, the railway likewise grew from single and double track to six-track lines (including the West Shore) and from the "De Witt Clinton" engine of 12,000 lb. to the newest Mallets with 466,000 lb. on the drivers.

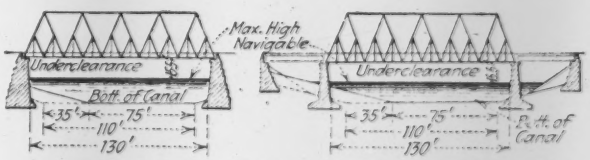
During the construction and growth of both the State's water and rail routes, each has accommodated itself to the requirements of the other, with the railroad yielding the more because of its greater flexibility. So, when the State launched the project of building the Barge Canal, plans were soon commenced to alter the railroad to meet the construction requirements of the larger waterway.

As indicated in the accompanying map, the new Barge Canal is located about 20 per cent on a new line, formed by excavating a channel across country designated as "Land Line"; about 50 per cent in existing navigable rivers designated as "River Line"; and about 30 per cent in the location of the old Erie Canal. The bridge crossings with the New York Central, indicated on the map and in the accompanying table by corresponding numbers, are naturally divided into two general groups: (I) New crossings and (II) reconstruction of existing river and canal crossings.

Nine new crossings were built at the points indicated in the table. As shown by the typical sketch, these bridges were built generally either of one through truss span supported by concrete gravity abutments on timber piles or, where the subsoil was swampy and yielding, of three spans; one truss and two plate girder approach spans supported on concrete piers and stub abutments.

BARGE CANAL CROSSINGS OF THE NEW YORK CENTRAL RAILROAD

	Location	Branch	Crossing	Type of Structure	Track Raise
1	Niskayuna	T. & S.		Change of line	2..6+
2	Schenectady	Maine line	Mohawk River	Reconstruction of piers	None
3	Hoffmans	Hoff's Conn.	Mohawk River	Not changed	.....
4	Utica 6.0 mi. E. of	Main line	Land	New bridge	1.2±
5	Utica 1.7 mi. N. of	Ogdensburg	Land	New bridge	9.8±
6	Rome	Main line, Industrial, Rome, Conn.	Land	Change of line and Two new bridg's	.....
7					.....
8	Brewerton	Watertown	Oneida River	Reconstruction	9.4±
9	Three River Point	Phoenix	Oneida River	Underpinning	3.3±
10	Syracuse	Syracuse Jct.	Land-Harbor	New bridge	9.0±
11	Fox Ridge	Main line	Land	New bridge	9.1±
12	Montezuma	West Shore	Land	New bridge	4.6±
13	Cayuga 0.2 mi. W. of	Auburn	Land-Lake	New bridge	12.4±
14	Cayuga 2.9 mi. W. of	Auburn	Seneca River and canal	Reconstruction	None
15	Clyde 2.0 mi. E. of	West Shore	Clyde River	Not changed	.....
16	Clyde 4.0 mi. W. of	West Shore	Land	New bridge	4.2±
17	Lyons 2.0 mi. S. of	Lyons, Newberry	Clyde River	Underpinning	2.9±
18	Lyons 1.0 mi. E. of	West Shore	Clyde River	Underpinning	None
19	Lyons 0.6 mi. E. of	Main line	Land	New bridge	1.2±
20	Newark 1.9 mi. E. of	Main line	Erie Canal	Underpinning	None
21	Newark 0.6 mi. E. of	West Shore	Erie Canal	Underpinning	0.5±
22	Pittsford	Auburn	Erie Canal	Reconstruction	3.9±
23	Pittsford	West Shore	Erie Canal	Reconstruction	3.6±
24	Rochester 3.0 mi. W. of	Main line	Land	New bridge	0.6±
25	Rochester 3.5 mi. W. of	Falls	Land	New bridge	1.9±
26	Lockport	Lowertown	Erie Canal	Reconstruction	4.9±
27	Lockport	Falls	Erie Canal	Not changed	.....
28	Tonawanda	Niagara, Towanda	Tonawanda Creek	New Pascule Bridge one combined crossing	.....



TYPICAL NEW CROSSINGS—MASS ABUTMENTS, PIERS AND APPROACH SPANS

An opening of 130 ft. clear width at right angles to the line of the canal was provided, the neat line of the abutment or piers being set 10 ft. from the bottom angle of the canal prism to allow a bottom width of 75 ft. and a future expansion of 35 ft. of additional bottom width. In like manner future expansion was provided for the railroad by constructing the substructure for one additional track, in the case of a single track line, and for two additional tracks in the case of a double or four track line. The depth of water from canal pool elevation to canal bottom is 12 ft. and the vertical under clearance is required to be 15.5 ft. from maximum high navigable water elevation, which is several feet above the pool level. To obtain this clearance it was necessary to elevate the tracks from one foot, at some loca-

tions, to as much as 12 ft. at others. Since the heaviest traffic is eastward, the runoff grades on the main line were made 0.25 per cent against eastbound traffic and 0.50 per cent against westbound traffic. On the branch lines the runoffs were made 1 per cent. In all cases grades were compensated for curvature. Traffic was carried on temporary detours of earth embankments around the bridge sites during construction.

Typical New Crossing.—The bridge built on the main line at Fox Ridge was typical of new crossing work. One of the photographs shows the work just after it was well under way with the various equipment, such as pile-drivers, excavators and pumps. It also indicates the location of excavation for the west abutment and for the cofferdam framing at the east abutment. The magnitude of the work is indicated, with main line traffic making a wide detour on both the north and the south sides of the new bridge. The other picture shows the pin-connected through truss nearing completion. Since the angle between the canal and the railroad is 45 deg. at this crossing, an unusually long span, namely, of 210 ft., was required. The approximate quantities involved, indicating the extent of the work at this and most of the other new crossings, were: About 100,000 cu.yd. of new railroad embankment, 10,000 lin. ft. of four-track roadbed rebuilt, with the necessary changes in telegraph lines, fences and signaling, 6,300 cu.yd. of concrete masonry, 30,000 lin.ft. of piling, 35 ft. long, and 1,400 tons of new steel superstructure.

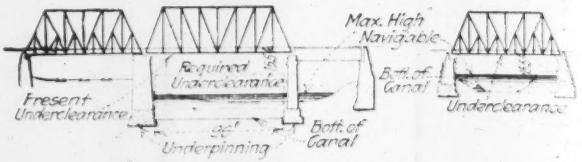
TYPICAL NEW CROSSING NEARING COMPLETION

The new bridge crossings were the first to be undertaken, as the negotiations with the State involved in them were the least complicated. Negotiations with the State are outlined in subsequent paragraphs. This work was commenced on Nov. 28, 1906, the date when the contractor commenced operations at the Barge Canal crossing on the Falls Road, 3½ miles east of Rochester.

Alterations of River and Canal Crossings.—Alterations of existing river and canal crossings involved bridges at thirteen locations, at six of which was required the reconstruction of the structures and at seven, underpinning or reinforcing of existing substructures.

Reconstructing of existing bridges, carried out at the locations indicated in the table and map, involved work similar to that performed at new crossings except that, instead of substituting a new bridge structure for an earth embankment, there was substituted a new bridge structure for an existing structure which did not provide an opening large enough to meet the Barge Canal clearance requirements. In some cases it was found advisable, in the interest of economy, to utilize an existing span, reconstructing the substructure and adding a second span to provide the greater lateral clearance required by the Barge Canal, as indicated in the typical sketch.

A typical case involved an old single-span structure of 120 ft., weighing 83 tons, for which was substituted



UNDERPINNING AT RIVER AND CANAL CROSSINGS

a two-span through truss bridge weighing 420 tons. Three methods were adopted for handling traffic during construction: First, by supporting existing bridges in original locations on timber falsework; second, by carrying the tracks on a temporary detour with timber falsework across the old channel, and third, by building a new bridge on a new alignment to one side of the original track, maintaining traffic over the old structure during construction. After the work was completed traffic was turned over the new line. In one case work was started with the intention of using a portion of the old substructure, substituting a through truss span for two deck girder spans, but as the work progressed it was discovered that, due to the condition of the old masonry and expense of maintaining uninterrupted traffic over the construction, it would cost no more to construct a new substructure on a new alignment to one side of the old alignment. An agreement was made with the contractor to carry out the work under the changed plan at the same cost as the original plan.

Where the Auburn Branch crosses the southerly end of Cayuga Lake there was an old lift bridge, providing about a 20-ft. opening, near the easterly shore of the lake. Two plans were studied to provide a new crossing: One, to substitute a new lift bridge substantially at the location of the old bridge, providing a wider opening; the other, to elevate the track about 12 ft. and construct a new opening with a fixed bridge about 500 ft. west of the old structure so that runoff grade could be made without disturbing the layout through the village near the passenger station. Taking into consideration the expense involved in perpetual operation of a lift bridge, as well as the difficulty of building a substructure of a lift bridge that would safely carry the concentrated weight of the lift span on yielding and swampy subsoil, the latter plan was found to be the more economical and was adopted.

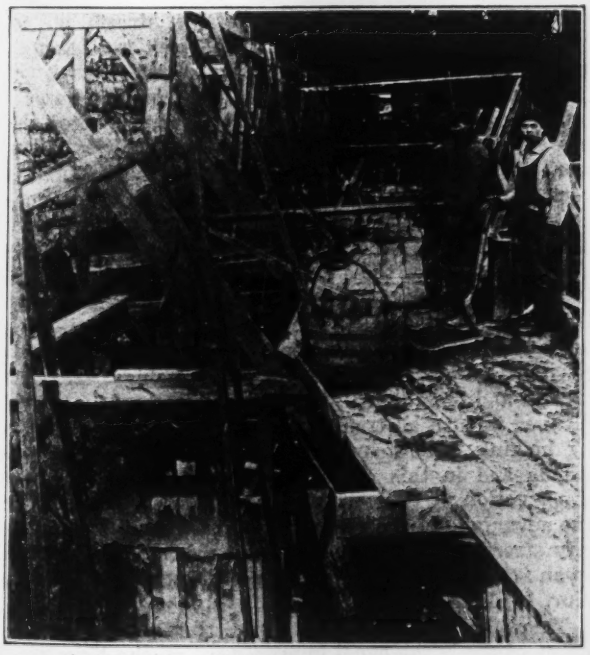
Underpinning Bridge Piers and Abutments

The work of underpinning and reinforcing the substructures of existing bridges to provide a deeper waterway, where there was sufficient lateral clearance not to require the reconstruction of the entire bridge, was carried out at six locations, as indicated in the table.

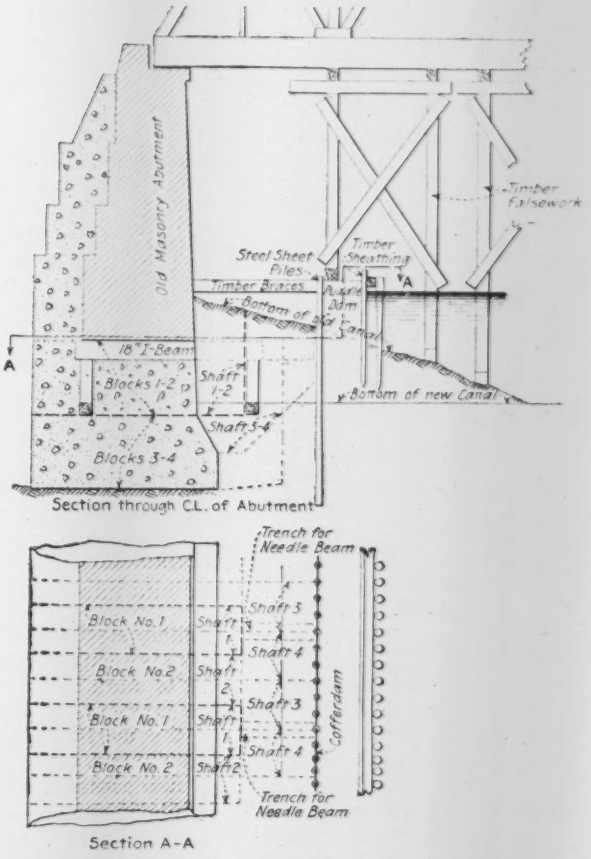
When plans were first discussed to provide proper barge canal clearances at these locations, the first thought was to build new bridges, as the difficulties of underpinning the substructures, while maintaining traffic on the railroad, with the interference of water, were considered too great. However, in view of the large expense that was found to be involved in the new bridge work, some of which had already been completed, it was decided in the interest of economy to

attempt underpinning the old substructures. Overcoming the difficulties attending this underpinning work was probably the most interesting single feature of the barge canal crossing work. For this reason a sketch is shown to indicate the general method adopted. Each location had its peculiar features, but the sketch and photograph are fairly representative of what was involved.

The first step was to construct timber false work to carry the existing superstructure and traffic and thus to relieve the substructure of this load. Then the substructure was surrounded by a puddle coffer dam with a row of heavy Lackawanna steel sheet piling on the side of the coffer dam nearest to the masonry and braced against the old masonry. Shafts were dug down in front of the old masonry and far enough apart to leave undisturbed a portion of the earth foundation as a support for the old masonry. It was not considered safe to dig these shafts all the way down to the new bottom; therefore, carrying the foundations down was made in two lifts. After the shafts, designated as number one, were dug, the masonry was undermined opposite and concrete placed in the portions undermined, designated as block number one on the sketch. After these blocks had set new shafts were dug alternately between the first shafts. Then the masonry opposite these second shafts was undermined and concrete placed in the undermined portions, designated as block number two. While these blocks were being placed the masonry was supported on the first concrete underpinning blocks. In some cases conditions were found so secure that the arch action of the old masonry between the supported portions could be relied upon to carry the masonry over the undermined portion. In other cases it was found necessary to drive 18-in. needle beams under the uncovered portion of the old masonry. The needle beams were supported on timber just beyond the limits of the old masonry and were concreted in and burnt off with torches at the neat lines.



UNDERPINNING WORK IN PROGRESS—SHAFT IN FOREGROUND



METHOD OF UNDERPINNING—COFFERDAMMING AND SHAFTING

After the blocks were constructed so that the new concrete underpinning was continuous for the first lift, a new series of shafts was constructed outside and adjacent to the first series of shafts extending down to the new bottom of the foundations. The work of undermining the concrete was carried on in the same manner as for the first lift, the location of the shafts being indicated as shafts number three and the concrete underpinning as blocks number three. This series of shafts and underpinning blocks were placed to break joints with the first set of shafts and blocks and in that way insured against a settlement of the underpinning already placed. One of the photographs shows a general view of the work and the timber false work support carrying the bridge superstructure during construction. The other shows one of the first set of shafts with a platform runway on top of the cofferdam to handle the material. As the placing of the concrete approached the under side of the old masonry, it was necessary, in order to get a good contact of the old and new masonry, to shoot this portion of the concrete in place by pipe and jet. In addition to the work of underpinning, the old abutments were strengthened by uncovering the backs of them and constructing a few feet of thickness of concrete carried to tie in with the underpinning, in order to increase the thickness of the abutment to the dimension theoretically required to conform to the increase in its depth. In some instances it was necessary to raise the superstructure a few feet in order to obtain the required vertical under clearance. This was accomplished either by putting new concrete bridge exten-

SUPPORTING SUPERSTRUCTURE DURING UNDERPINNING OF SUBSTRUCTURE

sions on the substructure or by installing steel I beam grillages at the bearing points of the steel superstructure on the old masonry. The amount of work involved is indicated at the main line bridge crossing the old canal near Newark, illustrated by the underpinning photographs, where there was about 5,000 cu.yd. of foundation excavation and 2,700 cu.yd. of new concrete.

At three points changes in railroad alignments proved necessary or desirable to accommodate the new Barge Canal: At Niskayuna on the Troy & Schenectady Branch; at Rome on the main line, and at Tonawanda on the Niagara and Tonawanda branches.

Change of Line at Niskayuna.—The state found it necessary to appropriate a stretch of single-track roadbed on the Troy & Schenectady Branch at Niskayuna, about 2,300 ft. long due to the impounding of the waters of the Mohawk River by the construction of a dam at the so-called "Vischers' Ferry" and the consequential flooding of the adjoining land upon which the track was located. This made it necessary to construct a new alignment of about 8,700 ft. at a location about 350 ft. south of and at an elevation about 22½ ft. higher than the old line, involving also changes in the track approaches to the new location and elevation which extended 15,200 ft. on the east and 1,700 ft. on the west, making a total length of new single track construction of about 5½ mi. This work did not involve the construction of any structures of importance, being practically no more than a fairly heavy steam-shovel grading job. While only the single track was reproduced on the new alignment, the roadbed was graded for a large part of the distance for future double tracking.

Change of Line at Rome.—The relocation of the main-line tracks at Rome avoided the construction of two four-track bridges of almost prohibitive skews; eliminated eight dangerous grade crossings; improved railroad alignment by the elimination of a sharp curve and by shortening the alignment about 1,700 ft. This was done by relocating the new railroad alignment on the south side and parallel to the new barge canal, which was along the south side of the city just removed from the business center. The railroad bed was constructed on a new earth embankment at an elevation high enough to cross the streets, the tracks being carried over some waterways on reinforced concrete arches. There was involved a relocation of about 20,000 ft. of main line and the construction of a modern brick station with island platforms, passenger subway and baggage lift; construction of six reinforced-concrete arch structures; three minor short span steel bridges and two double-track through truss bridges carrying branch railroad connections over the new barge canal; and about 2,500,000 cubic yards of embankment which was excavated from the new barge canal prism by a hydraulic dredge. This improvement was described in detail in the number of the *Engineering Record* of Feb. 21, 1914.

Change of Line at the Tonawandas.—The only work incidental to changing the New York Central Railroad to accommodate the barge canal that remains to be completed is the change of line at the Tonawandas. There is being constructed a new line about 10,300 ft. long as a new location for the combined Niagara and Tonawanda Branches through the cities of Tonawanda and North Tonawanda in order to cross the canalized creek by one bridge instead of rebuilding the two existing bridges and at the same time accomplishing a very desirable elimination of 13 grade crossings and the lengthwise occupation of the cities' principal business streets. This improvement requires the construction of a new double track, elevated roadbed on earth embankment carrying the tracks across the streets on 11 bridges, across the canalized Ellicott Creek on a through truss fixed bridge and over the canalized Tonawanda Creek on a single leaf Strauss heel runnion bascule bridge as well as the location and arrangement of the passenger station and freight station facilities. The work involved about 500,000 cu.yds. of earth embankment; 3,500 ft. of new street and about 3,000 ft. of concrete retaining walls, besides the bridge structures, four of which were reinforced-concrete arches where a sufficient elevation for them could be secured. The new line is complete in Tonawanda and the new bascule bridge is complete and in service for the Tonawanda Branch while the work in North Tonawanda, consisting of the construction of two street under crossings and new station and freight facilities, remains to be done. It is planned to turn all traffic over the new line this spring by making some temporary changes in North Tonawanda and in this way securing the use of the new construction at the earliest possible date and realizing the advantage of the abandonment of the old line in the city streets. This improvement was described in detail in an article by the author in *Engineering News-Record*, Nov. 14, 1918.

There are several other interesting phases of the effect of the barge canal improvement on the New York Central R.R.:

First—The state found it necessary to appropriate about 100 parcels of railroad property adjoining the barge canal other than that required for the crossings in order to obtain the required channel width and terminal facilities. There was considerable engineering work involved in negotiating with the State Special Examiner and Appraiser for a settlement of the damages arising out of the appropriation of this property. In each case an investigation on the ground was necessary to determine the location of the parcel of property with respect to the existing railroad facilities. Then plans and estimates had to be made with a view of ascertaining what would be the interference to existing railroad facilities and the impairment to future expansion. Frequently such an investigation would reveal another way of taking care of the state's need that would not require as large an appropriation of railroad property as was first anticipated.

Second.—The elimination of grade crossings at four locations, other than at changes of track alignment, resulted on account of the proximity of the new barge canal to the railroad. These eliminations were carried out at Palmyra, Galloways Highway, Port Gibson, Palmers Road, Fairport, Knapps Highway, Clyde, Sodus, Glasgow, Waterloo and Mill Street. Because the new barge canal was located parallel to and only a short distance away from the railroad at these points and because the highway or street crossed both the canal and the railroad (the latter had to be elevated to obtain the required vertical clearance of 15½ ft. over the canal) it was advisable and in some cases necessary to carry the highway or street on a structure over the tracks and accomplish the elimination of dangerous grade crossings. Such cases were carried out under mutual agreement between the State and the railroad, under which the state would construct and pay for that portion of the viaduct over the canal and the approaches, while the railroad built and paid for that portion of the viaduct spanning its tracks and right-of-way.

Third.—There is a very important effect upon the railroad due to the abandonment of those portions of the old canal which were no longer necessary upon the completion of the new barge canal. There are about thirteen of these crossings which may be abandoned, making it desirable to dismantle the old bridge structures and substitute for them earth embankments, thus doing away with the necessity of maintenance and renewal. Two of these bridges, which were located on the West Shore R.R., across the old Erie Canal, have already been dismantled and portions of the steel superstructures utilized in the new barge canal crossing work. A question is involved in relation to these bridges, because of a provision in the barge canal law which contemplates compensation being paid to the state by the railroad on account of possible saving that may be realized in the abandonment of old bridges, represented by capitalized cost of maintenance and renewal. As against this saving consideration must be given of the cost of taking down the bridges and substituting the earth embankments, and some times remodeling the substructure on account of providing for an opening for a highway.

Fourth.—The state authorities having control of Barge Canal matters have commenced negotiating with the various railroads looking to rail connections at some of the more important Barge Canal Terminals. There are some legal difficulties involved and the location of some of the terminals does not lend itself very readily to feasible rail connection. Nevertheless these matters are being given the necessary study looking to a solution of the problems involved.

Furthermore the state has provided means for the disposal, by sale, of the lands in the abandoned portions of the old canal which will be no longer necessary for canal purposes and because the railroad occupies and adjoins considerable portions of these lands. Steps are being taken to acquire these portions of the old canal lands which are needed on account of present occupancy and to provide for future extension of railroad facilities. For a long stretch along the southerly side of the Mohawk Valley the West Shore R.R. adjoins the old Erie Canal and considerable engineering study is required to determine how the old canal lands in this location can best be utilized for railroad purposes. When the West Shore R.R. was constructed in 1881 it was necessary to adopt a rather undesirable location for the railroad alignment in some places, on account of the Erie Canal being in a somewhat restricted valley between the Mohawk River on the north and the hills on the south. It may be possible some time in the future to correct the location of the railroad here and thereby utilizing some of the old canal lands.

Negotiations With the State

In the negotiations with the state for the settlement of cost of new crossing work, it was clearly established that, because the state required an opening through the roadbed and therefore the substitution of a bridge for an existing earth embankment, the damage to the railroad should be measured by the cost involved in building the new structure and in the capitalized increased cost of maintaining and renewing the bridge. In agreeing on the first cost of building the new structures, competitive bids were taken from various contractors and the low bid was used as a basis of settlement. The amount representing capitalized cost of maintenance and renewal was established by agreement, basing it upon past experience of various railroads and assuming a life of ten years for bridge decks and thirty years for bridge superstructures. The state in each case appropriated that portion of the railroad's right-of-way required for the construction of the bridge and the Barge Canal channel.

An interesting question arose in the negotiations leading to the carrying out of river and canal crossing work. The State had rather hoped that it would not be required to include the cost of this work in the cost of the construction of the canal, feeling that, where the canal was to be formed by deepening and widening of streams and rivers already navigable, such streams and rivers were public highways. There was also the opinion that, in some cases, the title to the bed of the streams was vested in the state, the bridges having been constructed over state property acquired under the old Dutch law. Naturally the railroad company, which had been operating over these bridges for many years under charter rights, contended that it should not be required to bear the burden of the expense of making the necessary alterations. It was finally decided that the railroad would go ahead and make the changes under plans and methods of execution to be agreed upon with the state engineer, after the state had appropriated whatever property right or easement the railroad had in the bridge structure as was required by the state to effect the deepening

of the channel, agreeing to submit to the Court of Claims the questions as to who should be obliged to bear the expense of the work. While the work is now complete, the question is still pending as to the settlement. However, it is interesting to note that there have been some court decisions, one being handed down by the Court of Appeals, bearing out the contention of the railroad that the expense of changing the various bridge structures to provide for the greater clearance should be included in the cost of the project as a whole, because the railroad bridges had been allowed to exist for a long time and such existence had not obstructed the kind of navigation that had been carried on. Furthermore, it was found that it was the intention of the Legislature to include the cost of this kind of work as a part of the Barge Canal project.

The negotiations arising out of the relation of the new Barge Canal construction to the New York Central R.R. were complicated, and at times the problems that arose were so complex and so difficult of solution that mutual agreement in regard to them seemed almost impossible. It was only because of the most cordial cooperation and patient efforts on the part of both the State and the railroad officials that construction work, without legal delays, was made possible. These negotiations were conducted by, and the construction work carried out under, the supervision of J. W. Pfau, engineer of construction, under the general direction of George W. Kittredge, chief engineer, New York Central & Hudson River R.R.

Traffic on Connecticut Roads

FIGURES were compiled during October and November indicating the average and extreme traffic certain Connecticut roads are called upon to bear. The figures of Nov. 5, 6 and 7 in the accompanying chart are self-explanatory, though those taken on Nov. 15

November 5, 1919	7 A.M. to 6 P.M.	
Hartford-Winsted Road	168	Passenger Autos
	32	Trucks
November 6, 1919		
Torrington-Waterbury Road	385	Passenger Autos
	168	Trucks
November 7, 1919		
Winsted-Torrington Road	219	Passenger Autos
	104	Trucks
Berlin Turnpike	631	Passenger Autos
	136	Trucks
November 15, 1919		
Washington Bridge (Milford-Stratford)	9712	
Derby Ave	6258	
East Haven	3544	
Woodbridge	1872	
Hamden	1788	
Berlin Turnpike	1697	
Durham Road, Middletown	748	
October 1, 1917 to September 30, 1918		
Saybrook-Lyme Bridge	88,408	Conn. cars
	32,906	Foreign cars
October 1, 1918 to September 30, 1919		
Saybrook-Lyme Bridge	115,691	Conn. Cars
	42,082	Foreign cars

include all vehicles. The Nov. 15 figures are extremely heavy owing to the fact that they were taken upon roads leading into New Haven on the day of the Yale-Princeton football game. Traffic, of course, covers the passage of vehicles in both directions, though even with that consideration it is seen that the Washington bridge along the Milford-Stratford Roard carried an average of fifteen vehicles a minute from seven o'clock in the morning to six o'clock in the evening.

Some idea of the yearly increase in the amount of traffic which highways will be called upon to bear in the future is had from the figures of the amount of traffic across the Saybrook-Lyme bridge over the Connecticut River from Oct. 1, 1917, to Sept. 30, 1918, and from Oct. 1, 1918, to Sept. 30, 1919. Both in the increase in the number of Connecticut cars and in foreign cars an approximate 30 per cent is noted. A yearly census over the Saybrook-Lyme bridge was possible because it is a toll bridge.

Reports Government Operation of Inland Waterways

A REPORT on the operation of boats on inland waterways by the Federal Railroad Administration during 1919 was made public just before the boats were turned over to the War Department, which took place on March 1, in accordance with the law ending Federal control of the railways. The report, made by D. A. Tomlinson, Director of the Inland Waterways, states that operations were carried on with unsatisfactory equipment, so that no fair test of the commercial possibilities of the fleets has yet been made.

On the New York Barge Canal no figures are given for financial results of operation, but it is stated that "the results of operations for this season substantiate the assumption that as soon as modern power barges now under construction are placed in service the operation of the waterway will become profitable." The Delaware & Raritan Canal carried 248,640 tons of freight both ways. The Government operated the canal and collected tolls but operated no boats. The receipts from tolls were $133,548 and the cost of operating the canal was $221,587, leaving a deficit of $133,548.

On the lower Mississippi, heavy losses in operation are assigned to a variety of causes. Five towboats and 29 barges began plying between New Orleans and St. Louis on Sept. 28, 1918, with the intention of rendering a weekly service, but defective power prevented success. A deficit occurred of $582,471.43; during what period is not stated. The underlying causes given for this result are (1) grossly defective power and (2) inadequate terminal capacity and facilities. The barges were delayed so long in port at each end of the voyage that only 44.3 per cent of their time was spent in transit. The cost of repairs alone to the equipment to June 30, 1919, amounted to over $65,000. The cost of handling freight at St. Louis and New Orleans respectively, not including the cost of rehandling freight transferred between cars and boats, was 96c. per ton at New Orleans and $1 per ton at St. Louis.

From April 30 to Sept. 30, 1919, the "interline" freight handled amounted to 12,893 tons carried at an average charge of $4.70 per ton. The local freight carried was 96,325 tons, on which the average charge was $3.54 per ton.

On the Warrior River, 124,648 tons of freight were moved between December, 1918, and Oct. 31, 1919—almost entirely coal. The deficit from operation to Oct. 31, 1919, was $136,635.91. The full capacity of the fleet provided, estimated at 300,000 tons, was not available until July, 1919. To develop a northbound traffic, 20 steel cargo retainers of 10-ton capacity each and terminal derricks are being installed at Cordova and

New Orleans. The fleet is to be supplemented with four self-propelled barges and three tow boats.

Director-General Hines, in submitting the report, said: "The results of operation of these waterways have all been during a period of partial initial development and hence the results cannot be taken as indicating what can reasonably be expected from these operations until a reasonable period of development shall have elapsed. I believe it highly important in the public interest that there shall be a thorough-going experiment with these waterways, and I shall be surprised and disappointed if that experiment does not show a complete economic justification of this method of transportation."

The British Ministry of Transport

RECENT events in England, and the increasing demands made upon our own transportation facilities, have quickened American interest in the British Ministry of Transport, created last fall by Act of Parliament, and a piece of legislation which gives to the Minister of Transport practically dictatorial powers over all means of transportation.

The act was introduced into the House of Commons in March, 1919 by the Home Secretary, Mr. Shortt, and was first entitled, The Ministry of Ways and Communication Bill. The bill had its inception in the conviction of the government that extensive and greatly needed economies could be secured through centralization of control of all means of transportation. Therefore, in its initial draft the bill proposed to centralize in a single government department all powers and duties of any government department in relation to railways, light railways, tramways, canals, waterways, inland navigation, roads, bridges, and ferries, and vehicles and traffic thereon, harbor, docks and piers; and the supply of electricity.

In addition to the Minister of Transport becoming the general director of all means of transport in England, the officers and employees of any of the services under his control were to obey his directions as to (1) rates, fares, tolls and tariffs; (2) salaries, wages, conditions of employment; (3) operation of any or all of the services under his control; (4) maintenance-of-way, rolling stock, motive power, plant appliances; (5) carrying out alterations considered necessary in the interests of public safety; (6) common use of facilities, rolling stock, equipment; (7) affording interchange of running powers over competing systems; and (8) furnishing statistical reports and reviews, and accounting statements such as the Minister might prescribe with the consent of the Treasury.

The act was introduced, as Sir Eric Geddes, the present Minister of Transport, asserted at the time of its introduction, "with a view to affording time for the consideration and formulation of the policy to be pursued as to the future position of the undertaking." As first introduced, the act therefore transferred to the Ministry of Transport from the Board of Trade the power of railway control, possession of which had been taken under Regulation of Forces Act, 1871, giving the railways the guarantee of the 1913 net receipts. In addition to the powers already described, the Minister was empowered to take possession of the whole or any part of any other railway, tramway, canal, inland navigation, harbor, dock or pier undertaking, and of the rolling stock of any private owner and of any barges, tugs and other crafts required for use on any canal, possession of which had already been taken. Giving such complete powers to some authority raised considerable adverse criticism among those enterprises involved, though the greatest point of attack upon the bill was its provision that any time within the two-year life of the act the railroads and other means of transportation could be nationalized through Orders in Council proceedings. So great was the pressure against this provision in the bill that the Minister-Designate of Transport, Sir Eric Geddes, withdrew the provision before the second reading of the bill in the House of Commons.

Panel of Experts Provided

After having been referred to committee and reported back in the House of Commons for its third reading in July, 1919, the act contained several new provisions, among which was an amendment to the effect that the Minister of Transport should set up a panel of experts from which to draw committees that would act in advisory capacity upon questions in which each service of transport was intimately concerned. Each committee was appointed from nominees, after consultation with the various enterprises and interests concerned, and of labor, trading interests, local authorities, and so forth. Also, through amendment the autonomy of the various docks boards, which had proved such strong organizations during the war, and before, was not disturbed. Considerable adverse criticism was directed toward the act for the inclusion under the Minister's management of roads, bridges, and ferries, on the ground that it was inexpedient to give one managerial head control over more or less competing lines of communication. However, this criticism availed little, and roads, bridges and ferries were included in the final draft of the bill. However, popular pressure did avail something, and the supply of electricity, originally given to the Minister of Transport, became the subject of a separate bill.

After its third reading before the House of Commons, it was sent to the House of Lords, where it went through its first and second reading with considerable discussion, was referred to committee, then referred back to the House of Lords and passed its third and final reading Aug. 12, 1919. The Act was, during its committee stage in the House of Lords, renamed the Ministry of Transport Act. It received royal assent Aug. 15.

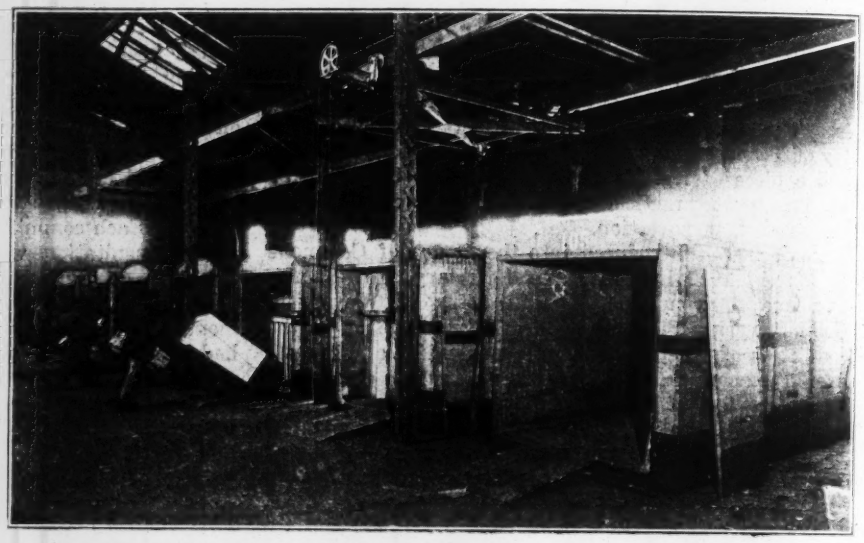
In its final form the Ministry of Transport Act conferred upon the Minister of Transport certain more or less absolute powers with regard to all questions of transportation. Although no system of transportation was longer capable of being nationalized by an Order in Council, the Minister was allowed to establish certain transport services and to work them either himself or through others, and was also allowed to acquire such land or easements as were necessary, either by agreement or compulsorily. However, in the exercise of such functions he was first to allow existing services to make such changes in transportation as he contemplated, and he was to submit an estimate of the capital expenditure involved which was to be approved by the Treasury. Details of his plan were to accompany such proposals, and if the estimates exceeded half a million pounds, or in case compulsory acquisition of land and easements was necessary, an order in council was requisite, a draft of which had to be passed by a resolution of both Houses of Parliament.

Motorized Freight Transfer Cuts Terminal Costs

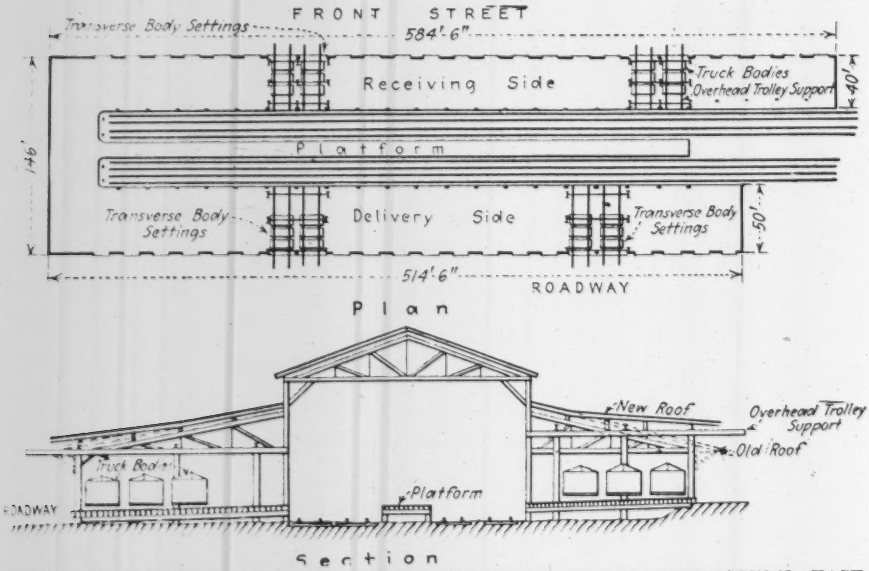
Installation for Railroads at Cincinnati Provides Mechanical Handling of Demountable Truck Bodies—Use of Station Trap Cars Practically Eliminated—Operating Results

AN ADVANCE movement of transfer freight of 52 hr. with a saving in cost per ton, as well as other economies, has been accomplished in Cincinnati by installing a system of motor trucking less-than-carload-lots in demountable bodies handled by electric hoists and cranes on overhead rails at main and substations, serving the seven railroads entering the city. All installations were made by adapting existing structures to the requirements of the system without erecting new buildings. Under the previous system, by trap car between terminals and horsedrawn drays, the average time of transfer was 2.6 days and this has been reduced to current movement, or an advance movement of 52 hr., with a saving in cost per ton of 35c., and an increase in available floor space and car-storage space, releasing cars for main-line service previously used as trap cars between stations. The operation of the system and the study which led to its adoption was described briefly in a paper before the annual meeting of the Material Handling Machinery Manufacturers Association in New York City, Feb. 26, by B. F. Fitch, president Motor Terminals Co., New York and Cleveland, which has the contract for handling the present motorized freight transfer business in Cincinnati.

It was estimated that about 65 per cent of the less-than-carload tonnage at the Cincinnati terminal was for transfer to connecting lines or substations. In 1917 this traffic exceeded the capacity of the company operating horsedrawn drays, and forced the use of additional trap cars for interline less-than-carload business, to handle the overflow and relieve congestion of floor space. In May of that year the Cleveland, Cincinnati, Chicago & St. Louis Ry. made a test installation between its five main and substations, and after a study of results by a committee of other railroads contracts were made in 1919 for installing the system to serve all of the main and substations in the city. Although the terminal is not yet fully equipped, the new system of transfer by motor truck in demountable bodies is now serving all of the roads entering Cincinnati. The system of operation requires an empty body for each movement between freight stations. Incoming freight is unloaded directly into empty demountable bodies, on the floor of inbound station platforms. At the larger stations, a typical example of which is shown in the plan herewith of the Vine St. Station of the Southern Ry., several locations for body setting are provided to cut down average trucking distance from cars. In this case, by having four body settings and by trucking to the nearest one with a body carded for connecting line or substation, the average trucking distance is reduced to about one-quarter of that under the old system. The method of loading into bodies is shown in the accompanying photograph.

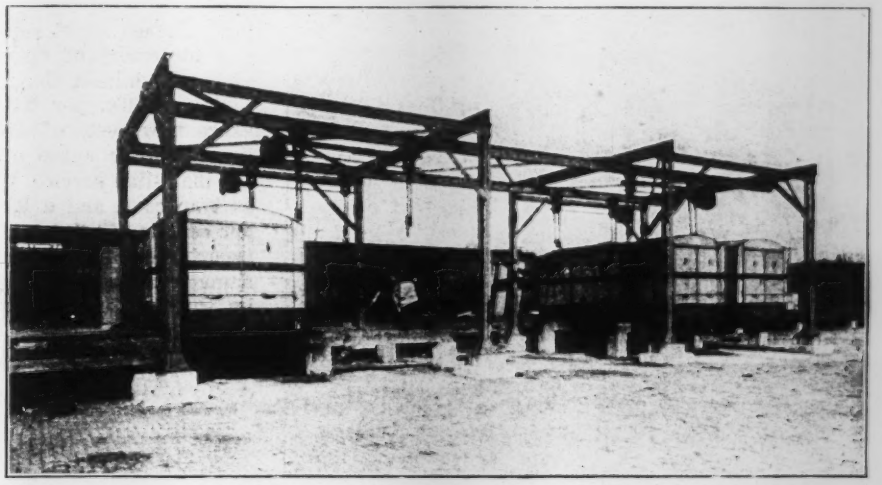


DIRECT LOADING OF FREIGHT FROM CARS TO A SERIES OF BODIES



TRANSVERSE CRANE WAYS NECESSITATED BY EXISTING SUPERSTRUCTURE—EAST END FREIGHT HOUSE OF LOUISVILLE & NASHVILLE R.R.

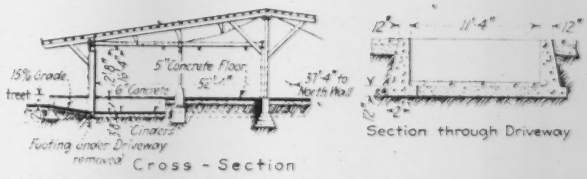
The loaded bodies are sealed; trolleyed to position and loaded on a truck, under telephone order of a dispatcher employed by the railroad. This operation is shown in the photograph. On arrival at the outbound platform of the connecting line the body is electrically hoisted from the truck and trolleyed into position. An empty body is then similarly loaded onto the truck chassis for delivery to the inbound platform of the same freight house, from which point the operation of unloading and reloading it with freight and delivering to another receiving station is repeated.



FRONT SUPERSTRUCTURE VIEW, BALTIMORE & OHIO SUBSTATION AT NORWOOD

At substations an outbound load remains on the platform until the dispatcher is advised by the agent that a return load is available. Then the loaded body is forwarded and exchanged for the previously reported load of outbound freight to be delivered at the main station, where it is consolidated with other city freight in line cars.

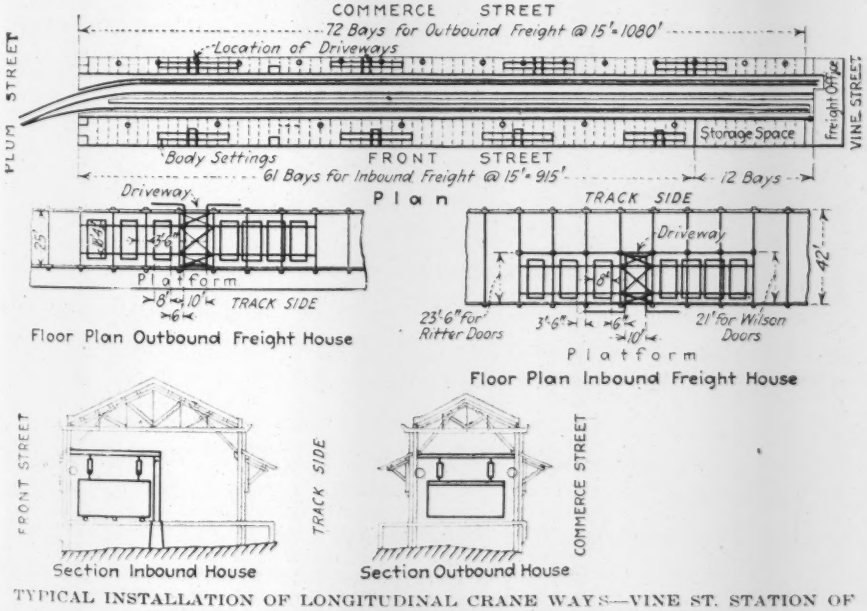
In making the installations at the various stations and substations in the city, it was necessary to adapt them to individual requirements and varying restrictions imposed by existing buildings. No buildings were erected specially for the purpose. It was necessary to make some building alterations for superstructures and to depress driveways to provide roof clearance for hoists and truck body trolleying. The accompanying drawing of the East End freight house of the Louisville & Nashville R. R. is a typical example of adapting the installation to existing requirements. Here it was necessary to arrange the crane ways transversely between roof trusses, instead of adopting the preferable longitudinal arrangement as at the Vine St. Station of the Southern Ry. It was also necessary to provide greater clearance for unloading bodies by changing the slopes of the roof as shown. Another example of adaptation was the Front St. installation for the Big Four, a section of which is shown in the cut. On account of the expense involved in providing more clearance by raising the roof, the driveways were depressed below street grade, with a 15 per cent approach grade leading from the pit to street level.



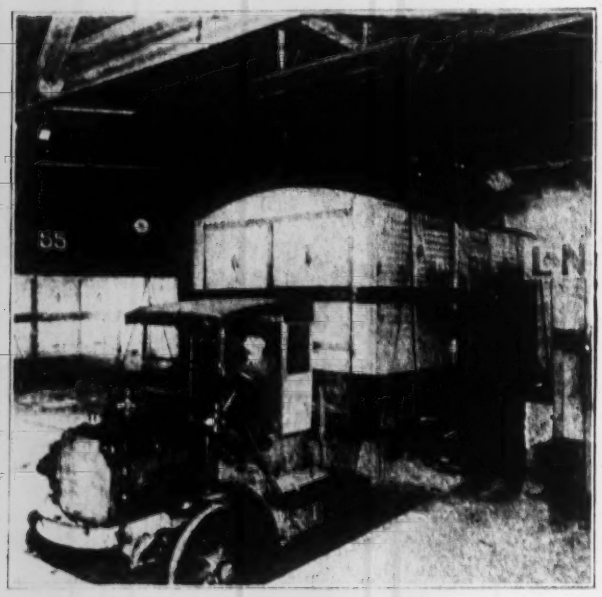
STREET LEVEL AND ROOF CLEARANCE AT BIG FOUR INSTALLATION REQUIRED SUNKEN DRIVEWAYS

The motor trucks used are of five-ton capacity with demountable bodies of steel and wood construction and inside dimensions of 7 ft. high, 8 ft. wide and 17 ft. 6 in. long. Electric hoists, consisting of special bridge frames with a patented weaving device (for aligning body with truck chassis) suspended on the superstructure, are provided to handle the bodies. The bridge frame is mounted as a traveling crane on ways supported by the superstructure. An automatic device is now being developed to connect the links of the hoist with the hooks on top of the bodies in loading or unloading. This is now done by hand, the two links on each side being held by a bar so that both may be connected to hooks at once by one man.

The Cincinnati Motor Terminals Co., the local operating organization, under the terms

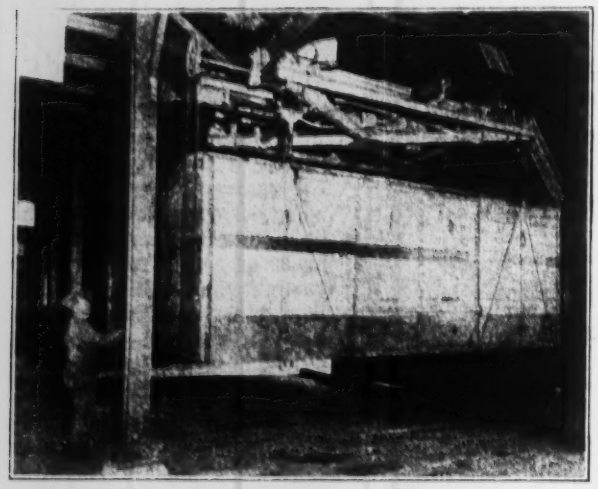


TYPICAL INSTALLATION OF LONGITUDINAL CRANE WAYS—VINE ST. STATION OF SOUTHERN RAILWAY—TRUCKING DISTANCE REDUCED



BODY TROLLEYED TO POSITION FOR LOADING ON CHASSIS—FRONT ENTRANCE PIT

of the contract with the railroads, has equipped all freight houses with demountable bodies to comply with movement and tonnage demands, electric hoists for the handling of the bodies and motor trucks. The company maintains and operates all of this equipment, which is utilized by the railroads under direction of a joint dispatcher, but without liability of operating contingencies. The Motor Terminals Co. is responsible for loss or damage of freight while in transit. The railroads purchase the service at rates ranging from 80c., for connecting-line transfers, to the maximum of $1.25 per ton for the longest haul of 10 mi. to any substation. There is no shipment minimum, but it was agreed that no body containing less than a two-ton tariff load would be dispatched by railroad, and if loads lighter than this were moved, the railroads would pay the two-ton minimum tariff. The railroads have installed a system of direct telephone communication from each superstructure point to a dispatch switchboard installed in the offices of the Motor Terminals Co. This gives the railroads direct supervision of the entire operation.



ONE MAN REMOVES BODY FROM CHASSIS AND TROLLEYS IT TO POSITION FOR UNLOADING

A statement of operating results furnished by the Motor Terminals Co. indicates that, in addition to a saving of 35c. per ton of freight moved and an advance movement of 52 hr., available floor space and track storage space are increased, cars are released for main-line service, through elimination of their use as trap cars, and a labor saving of approximately 30 per cent is effected in freight handling. The company reports that it has not had a single claim for loss or damage of goods. Operating cost figures furnished by the company, established during 100 days' operation, are as follows:

	Trap Car and Team Haulage		Motor Truck	
	Amount	Per Ton	Amount	Per Ton
Cost of transporting freight between connecting lines by trap cars	$92,685.07	$1.563		
Cost of transporting freight between Main and Substations by trap cars	20,588.45	1.437		
Cost of transporting freight between connecting lines by Transfer Co.	92,506.03	2.006		
Total cost of transporting all freight (119,799 tons)	$205,779.55	$1.718		
Labor cost chargeable to Motor Truck Transporting Cost				
A—Unloading freight from truck bodies			$51,321.89	$0.4284
B—Handling of removable truck bodies			2,525.36	0.021
Interest on superstructure investment			1,833.00	0.015
Fund for retirement of superstructure investment			3,055.10	0.025
Maintenance or repairs to superstructures, 1½ per cent per annum			458.24	0.0038
Labor cost for dispatching of motor trucks			2,400.00	0.02
Contract cost as submitted by the Motor Terminals Co.			102,068.75	0.858
	$205,779.55	$1.718	$163,662.34	$1.366
Present railroad cost per ton		$1.718		
Proposed contract cost, per ton		1.336		
Saving, per ton		$0.352		

A summary of other economies established by 100 days of operation, as reported by the company, follows:

1. Net economy of $0.352 per ton an item of $42,169.25 or $126,507.75 per annum.

2. Will advance movement of all freight from existing 62.4 hours by trap car between connecting lines, 55.2 hours by trap car between main and substations and 72 hours by Transfer Co., the average being 62.4 hours, to daily service (10 hours), of which 98 per cent will reach destination in time for current loading into main-line cars or for consignee's delivery at substations. This means an advance movement of freight 52.4 hours.

3. Continuous movement of freight by motor truck and system will only occupy 47,047 sq.ft., inbound house floor area transporting 100 per cent of freight, as compared to 94,923 sq.,ft. now occupied. This is an item of 47,876 sq.,ft. or 50.4 per cent platform area saved and equivalent to increasing platform tonnage capacity 498.4 tons daily.

Based on the total inbound house area of all main stations (324.261 sq.ft.) the increase of station platforms will be 14.8 per cent.

Outbound house floor area is a matter of station operation. Motor truck body area is 144 sq.ft. and loads average 4.55 tons; hence, if but one body is handled through a location daily, the square-foot-per-ton floor area occupancy cannot exceed 32 sq.ft. per ton, as established by test. If two bodies are unloaded in a location the occupancy is reduced to 16 sq.ft. per ton, if 4 bodies 8 sq.ft. per ton, etc. C., C., C. & St. L. Ry., practice 21 sq.ft. per ton.

4. Eliminating 154.25 trap cars daily releases station rails for car settings of equal number of line cars. 40.4 lineal ft. being the average rail space occupied per car, it shows trap cars require 6,232 lineal ft. based on the total main station rail space (29,042 lineal ft.) available for all house car settings, connecting line and sub-station trap cars occupy 21.4 per cent. Taking such cars out of service is equivalent to increasing station trackage 21.4 per cent.

Main station trackage (6,232 lineal ft.) occupied by trap cars and conceding 12 ft. center to center of rails, is equivalent to increasing station realty 74,784 sq.ft. or 21.4 per cent of all available (248,504 sq.ft.) main station trackage realty.

5. Trap cars released for main-line service 22,287.5 an item of 66,862.5 cars, per annum. The earning capacity of these cars is creditable to motor-truck operation. No authentic record available.

6. The extension of present available labor through elimination of freight rehandled (86,976 tons) amounts to 30.4 per cent of total tons (285,790) handled at time of loading and unloading cars. This percentage of labor diverted to direct run of freight will tend to decrease the demand for freight house labor.

7. Elimination of 86,976 tons of freight rehandled lessens liability of loss and damage.

The system of truck transfer so developed by the Motor Terminals Co. now serves the following railroads entering Cincinnati: Cleveland, Cincinnati, Chicago & St. Louis R. R.; Pennsylvania R. R.; Norfolk & Western R. R.; Louisville & Nashville R. R.; Cincinnati, New Orleans & Texas Pacific R. R.; Chesapeake & Ohio R. R., and the Cincinnati, Lebanon & Northern R. R.

Fine Screen Specifications for Activated Sludge Plant at Milwaukee

TO give all makers of sewage screens a chance to bid on the large installation of fine screens for the Milwaukee activated-sludge plant, the Sewerage Commission has adopted general specifications prepared by T. Chalkley Hatton, its chief engineer. Bids will be received on April 8. Each bidder must submit detailed plans and specifications, subject to the approval of the chief engineer. Contracts will cover screens, brushes, conveyors and liming mechanism only. The specifications in part are as follows:

The work to be done by the screens is the passing through them of an average dry-weather flow of sewage of 130,000,000 gal. per day of 24 hr., containing from 225 to 300 p.p.m. of suspended matters in the raw sewage with a loss of head not exceeding 4 in. and an additional storm-water flow of 190,000,000 gal. per day with a loss of head not exceeding 12 inches.

The number of screens installed shall be such that the above named quantities of liquor may be satisfactorily passed without using one screen, which shall be installed as a spare unit and which shall have a capacity equal to any other single unit installed.

Every type of screen considered shall be composed of a manganese bronze, brass or copper plate, built in sections with the two faces of the plates on parallel plans, sections accurately fitted, and securely and rigidly supported by a steel or semi-steel frame of ample strength, to which they shall be attached by means of non-corrosive screw bolts or in some other manner satisfactory to the Chief Engineer.

The screen plates shall not be less than $\frac{3}{16}$-in. thick and shall have slots cut in them $\frac{3}{32}$-inch minimum width by from 2 to 2½ in. long. These slots shall be reamed on the under side to an angle satisfactory to the Chief Engineer and both faces of plates shall be free from burs or any other defect. The slotted or effective area of plate shall not be less than 26 per centum of the plate area.

If the type known as the Riensch-Wurl screen is used, no unit shall exceed 26 ft. diameter. If the belt screen is used, no unit shall have an effective screen width of over 6½ ft. and an inclination of not less than 18 nor more than 20 degrees from the horizontal. If a cylindrical screen is used, the effective length of screen surface shall not exceed 10 ft.

Every type of screen submitted should provide for removing the screenings by means of brushes mechanically operated synchronously with the screen, and shall be so installed as to deliver the screenings from all screens to a common belt conveyor. The brushes shall be of a material satisfactory to the Chief Engineer, provided with satisfactory adjustments with bearings of the best type and workmanship, and so arranged that when operating the screenings will not be swept through the slots of the screen.

Belt screens should be provided with facilities for adjustment in taking up slack.

Each screen shall be driven by a separate motor to be furnished and installed by the Contractor and should be supported upon the framework of the screen. There shall be inserted at some convenient point in the driving mechanism, a shearing pin or other suitable device for breaking power, should the screen be subjected to any undue strain.

The motors shall be of a type satisfactory to the Chief Engineer for A.C. 60-cycle, 3-phase, 220- or 440-volt, of a speed not exceeding 1,200 r.p.m. and of sufficient capacity to provide easily for starting torque. The make of motor shall be designated by the Chief Engineer to correspond, as near as possible, with the make to be used in other parts of the disposal plant.

The Contractor shall furnish and set up, where directed by the Chief Engineer, switchboard. . . .

The Contractor will be required to file a bond with his contract for one-half the amount of the contract to guarantee, for a period of two years after acceptance, that he will replace, without cost to the City of Milwaukee, any part or appliance furnished by him in installing the plant which shows within that period defective workmanship or material or that it is not adapted to the purpose for which it was furnished.

It should be understood that no opportunity may be afforded for supplying the plant with sufficient normal sewage to test its operation for one year after its completion, and the period of guarantee is placed at two years; but if the progress of the sewage disposal construction is such that one full year's operation of the screens can be obtained in less than two years after completion of screens, the guarantee period will end after the one year's operation.

Before acceptance of the final plant, and final payment is made, each screen unit shall be operated by the Contractor under the Chief Engineer's direction to test out its mechanical operation. This test shall continue as long as the Chief Engineer deems necessary for him to determine whether each of its parts is in satisfactory operating condition, provided such period does not exceed ten (10) days for any one unit. . . .

Payments for the installation will be made as follows: 50 per cent of the total contract price upon delivery upon the ground of the materials comprising the installation; 25 per cent when, in the opinion of the Chief Engineer, the plant is 75 per cent completed, and the balance within 30 days after its final acceptance.

Service Tests of Treated Ties on the Lackawanna Railroad

Results of a ten-year service test of treated ties on 76 mi. of main, third, fourth and side tracks of the 28-mi. line of the Delaware, Lackawanna & Western R.R. in New Jersey were reported by a committee on tie-service tests at the recent meeting of the American Wood Preservers' Association. Creosoting by the Lowry empty cell process is employed, with an average retention of 2½ and 3½ gal. per tie for 6-in. and 7-in. ties respectively. Of 200,000 treated ties laid in 1910 and 1911 only 64 had been removed up to the end of 1913 on account of failure, while 146 had been removed on account of damage by derailment. All ties are adzed and bored at the plant before being treated. Tie plates are used, but the committee does not consider the present protection against wear sufficient to enable ties on sharp curves to give the full life due to treatment.

Traffic and Prospects of the New York Barge Canal

THE business and prospects of New York's canal system are described in the annual report of Edward S. Walsh, Superintendent of Public Works. The total tonnage carried on all the canals last season was 1,238,844 tons, an increase of 7 per cent over the business of the previous year. This is the first time for many years that an increase of traffic has occurred. During the last decade, traffic on New York canals has been declining at an average rate of about 15 per cent per annum.

Of the total above recorded, 842,164 tons were carried in the Erie Canal; and two-thirds of this freight was local. The total through freight over the Erie Canal was 198,507 tons eastward and 80,627 tons westward. About two-thirds of all the canal business is low-grade freight, classed as "products of the ground," 591,106 tons, and "products of the forest," 194,807 tons. The total of manufactures and farm products shipped on all the canals was about 430,000 tons.

In 1880 the Erie Canal carried over 30,000,000 bushels of wheat eastward from Buffalo. Last year the total receipts of grain by lake at Buffalo were below 1,000,000 tons. Mr. Walsh ascribes this to the Government control over the grain business and the railways, and the decision to move it by all-rail routes instead of by water. In 1880 over 10,000 boats were in operation on the canal and were largely engaged in carrying grain. Last year there were 727 barges of all descriptions in operation, of which 415 navigated the Champlain division, leaving only 312 boats in use on the Erie Canal and its collateral branches. Except for a few new type barges—most of them built by the Federal Government—these boats are the old 240-ton Erie canalboats. These canalboats made 1,728 trips loaded and 970 trips light, and their average movement for the season was 1,706 mi. Their average run per day when on a voyage was 27.1 mi.

Of the business done on the canals, a large part is still in the hands of inedpendent boatmen. Mr. Walsh declares, however, that this system is archaic and does not meet the demands of shippers. "No appreciable success in the development of canal traffic can be had as long as the situation is controlled by the individual operator." Mr. Walsh condemns the Federal Government operators on the Erie Canal in unqualified terms. Last season, the Government placed in service 57 steel barges, 3 concrete barges and 3 wooden barges of the 150-ft. or so-called 750-ton type. It chartered tugs to tow these barges, but the tugs had not sufficient power to handle these large boats, and in several instances the barges got out of the channel and enadngered the canal structures. Concrete barges are considered a failure for this service. They draw over 4 ft. empty, which is over a foot more than steel or wooden boats of the same displacement. This mean a great deduction in carrying capacity and eliminates the concrete barge from commercial use.

These Government-operated barges carried 194,352 tons last season or less than 16 per cent of the total canal traffic. The Government boats, however, were operated exclusively in the through traffic between Buffalo and New York, and of this traffic about 70 per cent was carried on the Government boats. The Government agreed not to influence the movement of grain traffic and permitted independent boat owners to compete for cargoes on the same terms as the Government. Mr. Walsh believes, however, that private enterprises will not build boats to compete with a Government service which can operate without regard to cost.

Discussing the prospects for revival of business on the canal, Mr. Walsh says, "The formation of carriers for the new waterway falls short of reasonable expectations." He believes that large shippers of freight will have to take a financial interest in boat lines if business is to be restored to the canal.

The total expenditures during the year in the ordinary maintenance and operation of the canals was $1,774,116. In addition $598,437 was spent under various special appropriations, including about $150,000 to tow the boats of independent owners at less than cost. About $4,000,000 was expended in further construction work at the canals and over $2,000,000 on the canal terminals, making a grand total outlay on canal works by the state in 1919 of $8,496,747. Superintendent Walsh urges that the State should undertake the construction of grain elevators for canal-barge use at New York City and at Oswego, and should either buy or build one at Buffalo.

A Knellogy

BY PERCY G. SMITH
Civil Engineer, Wells River, Vt.

The sunset tells the knoll of parting day,
The chainman carelessly winds up the tape,
The transitman now homeward plods his way,
A threatened thunder shower to escape.

The axeman swears as barb wire tears his pants,
A clumsy rodman falls and breaks the rod,
The levelman now does a Spanish dance,
On stirring up some wasps beneath the sod.

Back yonder in that wooded swamp and bog
Is our external secant and P. I.
The chief had shown while looking up his log,
That sort of humor not described as dry.

The stakes across that meadow were left out,
A sign, "No Trespassing," was up to warn,
An irate farmer put us all to rout
Because he thought the line went through his barn.

Some tales of engineers the senses thrill,
Of burying a dead-man in the street,
Of making streams of water run up hill,
Or how a chainman dropped a hundred feet.

A railroad survey stirs the country-side,
The man in boots and corduroys adored,
His right of way is four or five rods wide,
And when he leaves, forgets to pay his board.

Some future time when estimates are read,
While standing on this very spot—right here,
Some contractor or other will have said:
"Here lied a most uncivil engineer."

Correction in Lake Huron Elevation

In the article by F. P. Shenehon entitled "Plan to Regulate Great Lakes Level by Niagara Dam," *Engineering News-Record*, Feb. 12, 1920, in the map on p. 308 the elevation of Lake Huron is given as 246.2 ft. above sea level. This is a draftsman's error. The proper elevation is 581.3 ft. above sea level.

Early Days in the North Country

By Henry K. Wicksteed
Chief Locating Engineer, Canadian National Railways, Toronto

FEW people who ride over the Canadian Pacific Railway or the Canadian National Railways to the north of Lake Superior, in these days of comfort and luxury, and view the rough broken country from the windows of a sleeping or dining car, have much idea of the rough life and patient plodding toil and thought that was put into the early surveys and explorations.

That there were few casualties and little illness shows that the strenuous life and constant exposure of the North country life is not unhealthy, nor does it break a man down and prematurely age him, provided he is well fed and suitably clothed. The native Indian, it is true, is dying out—but as a result of his contact with civilization, not the want of it. His diseases are all civilized, the most fatal of all being consumption, of which he knew nothing before his acquaintance and partial adoption of the White Man's modes of life, and unfortunately of his vices.

The Indian

The native Indian, as I knew him 40 years ago, was nearly always respectable, often most estimable in character, and physically he was a marvel. Generally slight, seldom above the middle height, he could carry a load on his back such as would make most men gape in astonishment. Two hundred and fifty pounds to three hundred was only a fair load; five hundred was common on a short portage, and I have seen seven hundred carried for a short distance. Not only his strength, but his endurance, was wonderful. He would travel for days at a time, thirty or forty miles a day, and perhaps would turn up at the White Man's camp and sit quietly down in a corner smoking his pipe. After (not before) being offered a meal, he would tell you that he had eaten nothing for 48 hours. He would sleep in a bush camp with only a single blanket, and the thermometer at minus 30°, and forget to mention it as a matter of interest. He would haul a toboggan as heavy as himself all day long without a murmur.

As to honesty, the Indian set an example to the White Man in those days, and generally, not always, the latter lived up to it. Locks and keys were unknown outside of the Hudson Bay Company's posts, and the trapper's cabin was always open to visitors, whether the owner was there or not. Property of almost any kind could be left almost anywhere with the practical certainty of its being untouched, provided it was left in such shape that the owner's intention to return was evident.

A traveller, for instance, would be overtaken by winter frost, and have to abandon his canoe. He would turn the canoe upside down, cover it with brush, and leave it with the practical certainty of finding it untouched in spring. Similarly with food. I have known a railway commissariat officer with heavily loaded canoes (confronted by low water conditions with shallow rapids and log jams) to leave a couple of tons of flour on an island in Lake Wabigoon. It was not carefully cached, and a much respected friend of mine, Koggiwaosh by name, happening to pass by, noticed that damp moss and field mice were doing it lots of damage. He straightway cut poles, made a proper cache, and left his two boys to watch it, but took nothing away. Such occurrences were common in the North woods, but I regret to say *Nous avons changé tout cela.* No cache can be left now without a man in charge, and the pathos of the thing is that our church bodies have spent thousands and tens of thousands in missionary work since then. Koggiwaosh was a pagan Indian, but not, it will be admitted, a bad specimen of a Man.

Some of the younger men on the railway surveys emulated the Indian, and became fairly proficient as axemen, packers and canoemen. To some of them, the woods life seemed the natural and desirable one. Some of them joined the Northwest Mounted Police, and became the most efficient of the force. Many of them never got back to fully civilized life in its entirety, except for an occasional spree in the nearest city. Few of them are left alive now, but if you meet any of them you will find them interesting to talk to, although not given to continuous talking. Always they are kind-hearted, and always intelligent; the North woods is no place for the stupid man.

There were many adventures in those days, and a few tragedies. The most numerous deaths were caused by bush fires, and fire is still the most terrible enemy to be met with in all the North country. One single bush fire accounted for eight victims out of a single party. Several more were drowned, but not so many considering the vastness of the lakes, the turbulence of the rapids, and the fragility of the craft used. To a man who spends part of every day in a canoe, it becomes like a bicycle to an expert—the balancing is unconscious and automatic. A man's equilibrium is unstable even when he is standing on his own feet, but it is hard to knock him down unless you take him unawares.

Through Thin Ice

Lake Superior was among the most dangerous of our navigation routes, but not because it was big and "treacherous," or at least only indirectly so. Lake Superior is so big that it never freezes entirely and is navigable all the year round in some parts, but there is danger in the navigation in winter because the smaller harbors freeze over, and in days of storm and stress, it is hard to make a landing. However, up to the end of January, we used our boats constantly, and took to them again in March, but we had to watch the weather closely. On still cold nights, a light skimming of ice invariably forms along the shore. When the sun gets up, a breeze, sometimes a very fresh one, starts to blow from the shore. This skim of ice starts for the open lake, thickening as it goes. If a boat gets outside of a sheet like this, it may drive him miles out to sea before the swell following breaks it up, and if one attempts to break through it, it is astonishing how soon it will cut through one's boat or canoe. Many fishermen and travelers have been cut off in this way, and their boats sunk, before they could get back to land. The writer got very badly caught in a similar way by having the wind drop while he was crossing a wide bay. The ice began forming immediately. To row on meant that in ten minutes or so, the planking would be cut through, and we should sink in deep water. To stop meant that we should have to wait at least 24 hours for the ice to get strong enough to walk on, and should freeze to death. There was a second alternative which we tried successfully. Everything was moved aft until the bow was out of water. Luckily, the load was not too great to admit of this; and then we paddled gently forward, bearing the ice down

as we went. The sharp edge merely chafed the planking, but did not cut it. It took an hour or more to reach the shore, and the boat was badly damaged, but still floated.

Of course, the wind is not always offshore—only on bright sunny days. Often the thermometer rises during the night, and a storm with snow comes in from the southeast, accompanied by a heavy swell which breaks this young ice into slush, and throws it high on the rocks. There is no traveling to be done on those days, and nothing to do but hunt up a well-sheltered spot, and make as comfortable a camp as possible. It was one of these changes that got us into a still more sensational predicament, although not perhaps any more dangerous.

Jumping Ice Cakes

Two Indians and the writer had coasted along the north shore very successfully for some sixty miles, to the end of Nipigon Bay, toward the middle of January. Here we found landlocked water and, as we expected, solid ice. So we laid up our boat and packed our stuff on a toboggan, which we obtained at a nearby Indian camp, and after spending the night with them, we started out. The two Indians pulled in front, I pushed behind with a pole. A few miles ahead was a bold point reaching far into the bay, and opposite to it was a channel out to the main lake. We had been warned by the Indians that the ice was new here, and that we had better take a portage over the point, which was several hundred feet high. But this meant a very arduous climb with the heavy toboggan, and we concluded to risk the ice.

All went merrily for some time. The new ice was reached, black and hard, and quite bare, and fully four inches thick. "What timid creatures those Indians were, anyway, trying to get us to lose time, and use up our energy hauling a toboggan up 500 feet, only to go down the other side."

We rounded the point and struck across the adjacent bay for some four miles. We got halfway across it, and still everything went well. Then I detected a slight swaying motion, and thought I must be bilious, but presently the swaying became unmistakably real, and the ice began to undulate. The wind had changed outside, and the swell was coming in from the big lake! We pulled a little harder, but felt no alarm; but the undulation got more and more pronounced, and presently, so steep that the ice could bend no more, and c-r-r-ick!!! a big fissure opened! We jumped it and pushed on. Crack! Crack! Crack! in every direction. And soon we were jumping from one cake of ice to another. The shore was still a mile away—the water commenced coming over the ice—and the toboggan very hard to pull. Wood runs very easily on dry ice, but not on wet. Not only did the cracks open everywhere, but they closed again with a bang, and we had to look sharp to keep our feet from being crushed or nipped off.

Presently the pack strap by which one man was pulling broke. He looked around for a moment, and then started off on the jump. The cakes were now so small that they would not bear our weight, and we had to run on them like a lumberman across a band of saw logs. The other Indian pulled for a few seconds longer, and then he broke for the shore, now only a few yards away, and I followed. Luckily for us, the little wind there was, blew on shore, and the ice crowded up closer and closer and doubled up—the edge of one cake under that of the next. The toboggan was partially submerged, but still floated.

In half an hour the packing of the ice was sufficient to carry us, and we went out gingerly and brought the toboggan ashore. As it was getting late, and everything was wet, we made camp in the woods nearby. The night turned bitterly cold, blankets froze like boards, and there was no sleep for us that night. The wind came out of the northwest again, and the ice we had traversed the night before was all gone in the morning, but we had reached the land-locked part of the bay, and there was solid ice with snow on it for the 30-mile tug to Nipigon Village, which we reached late at night.

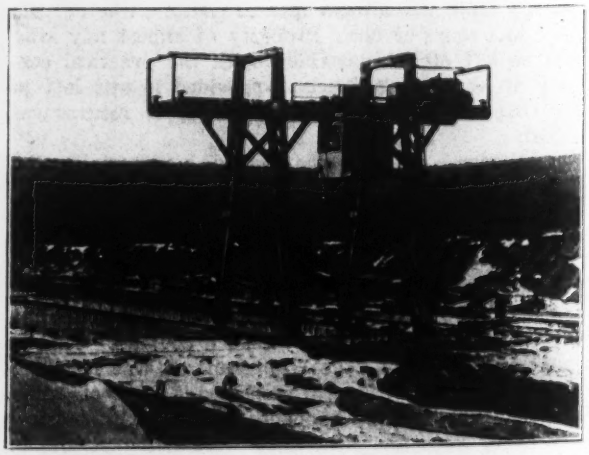
I don't think any of us ever ventured again on young ice exposed to the swell from the open lake.

New Engine Terminal for Lehigh Valley Railroad

Built by Forces of Company at Ashmore, Pa., Nearing Completion—Engine House, Coaling Station and Ash Pit Details

BUILT in emergency by the forces of the railroad company, a new engine terminal for the Lehigh Valley R.R. is nearing completion at Ashmore, Pa. Previous to the middle of 1918, when construction started, the need for additional engine facilities became apparent on the Mahanoy & Hazleton Division, serving the coal-mining district west of Penn Haven Junction on the main line. Existing facilities were located at Hazleton, four miles west, and Weatherly, five miles east of Ashmore. It was decided to locate the new terminal at the junction at Ashmore, about three miles east of Hazleton, equipped for light repairs, coaling, ashing, and storage.

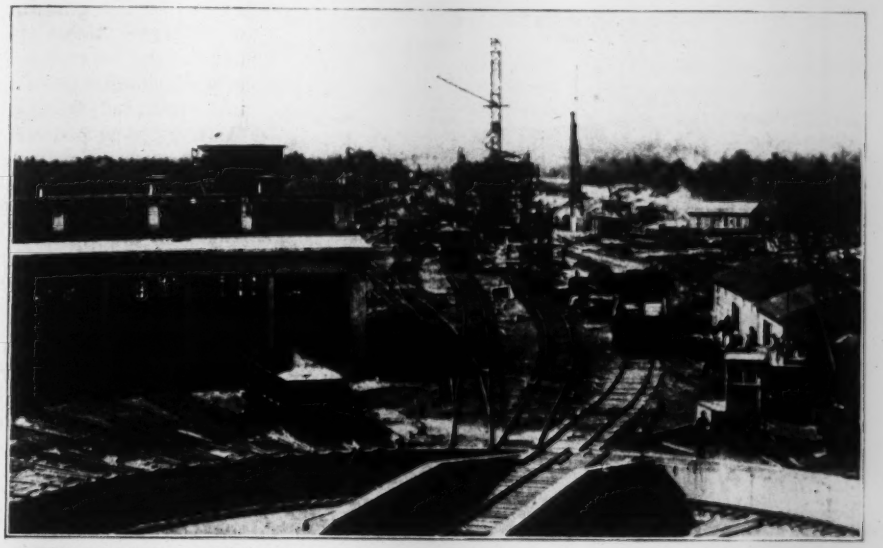
Since property was not available at Hazleton to expand existing roundhouse facilities the location of the new plant was determined as south of the Y at Ashmore, where property was available and existing structures would not prevent free design. As shown in the accompanying drawing, the new terminal comprises receiving yard, engine house, machine shop, transfer table, coaling, water and sand stations, ash pits, service



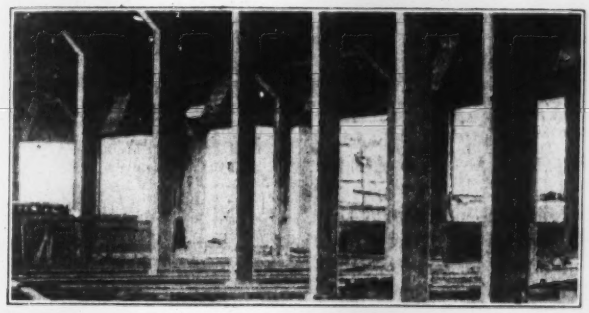
GANTRY AT PITS TO HANDLE ASHES INTO CARS ON CENTER TRACK

building and power plant. After the approximate layout had been determined it was "fitted" to a contour map, shifted and revised in order to minimize excavation, which was largely in solid rock.

For ashing, engines are received on tracks 4 and 2, from which they may coal and take water or proceed direct to the engine house. Track 5 is used for storage and track 1 for direct connection with engine house or power-house coaling track. It is planned that the through track from engine house to transfer table will be used almost entirely, rather than the emergency track connecting from the east end to the transfer table, in taking



ENGINE HOUSE LOOKING TOWARD COALING STATION DURING CONSTRUCTION

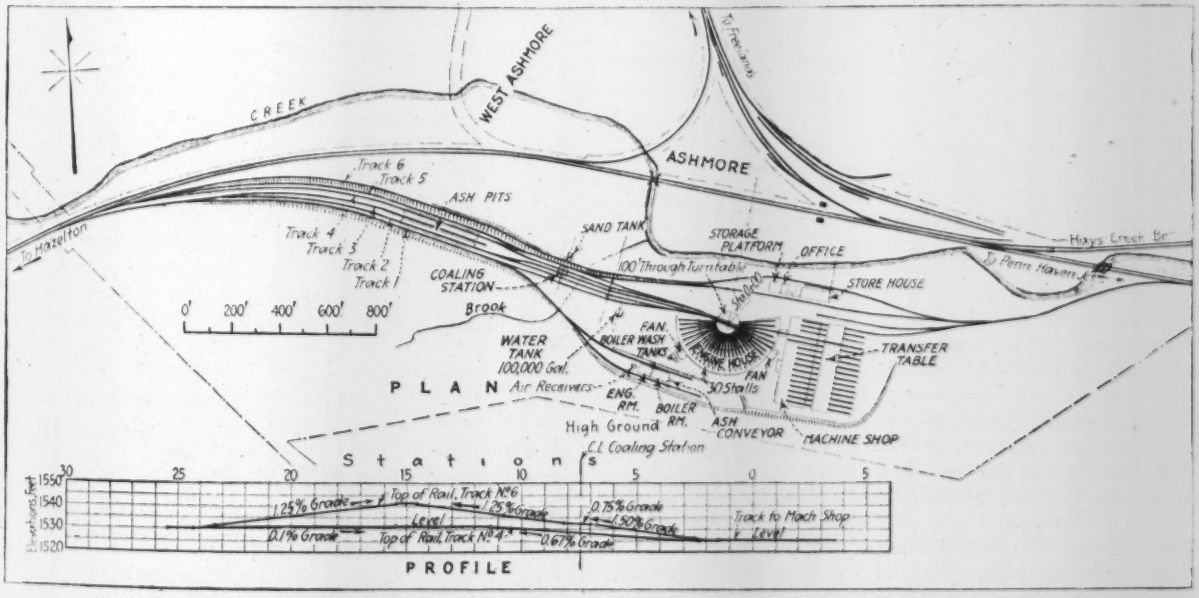


INTERIOR OF ENGINE HOUSE SHOWING SMOKE-JACK CONSTRUCTION

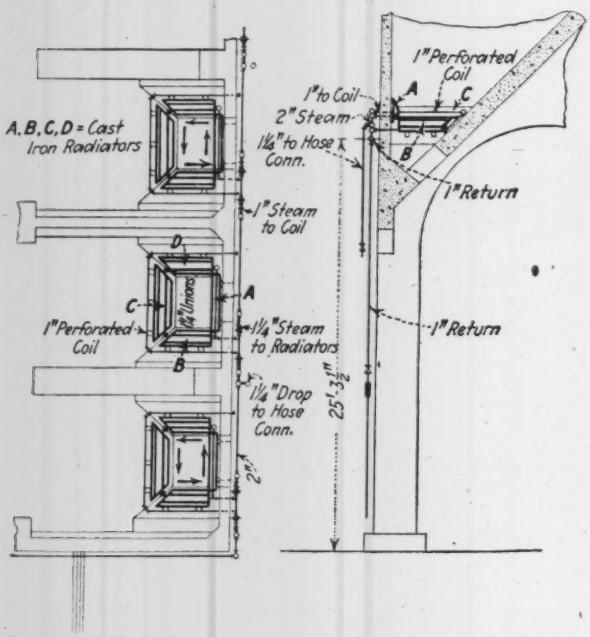
dead engines into the machine shop for light repairs. These facilities, together with those already existing, will provide for about 500 locomotives operated on the division.

All of the buildings are of reinforced-concrete construction. The engine house has thirty stalls, served by a 100-ft. through turntable. It is of reinforced-concrete throughout, including columns and roof. To save expense and to provide a rigid structure, the lower portion of the smoke-jacks, including the hood, were cast integral with the roof. Details of the construction are shown in the accompanying drawing. The upper portion or stack was cast separately and fitted with mortar after the roof was complete. The walls of the hood, or lower portion, which is 12 ft. long at the bottom, are only 2 in. thick. Their appearance from the interior of the engine house is shown in the photograph.

The coaling station is of the reinforced-concrete type. Since considerable difficulty has been experienced by the company in the freezing of coal just above the gates, it is planned to equip them with a system of cast-iron steam radiators and perforated steam coils, details of which are shown in the drawing. Previously, when freezing occurred in very cold weather, it was the prac-



ENGINE TERMINAL FOR LEHIGH VALLEY R.R. AT ASHMORE, PA., BUILT BY COMPANY'S FORCES



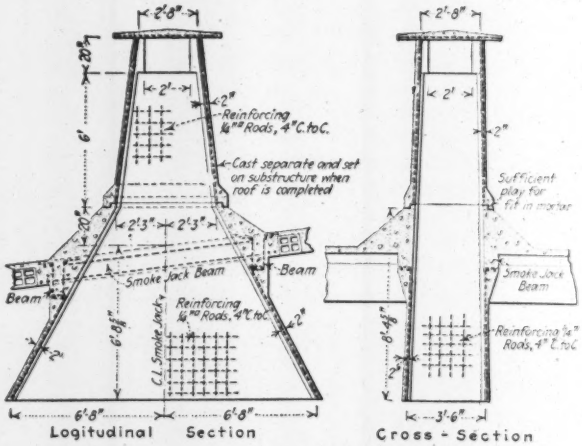
CAST-IRON RADIATORS AS THAWING EQUIPMENT FOR COALING GATES

tice to inject live steam upward through the gates. While this would thaw out the frozen mass, it would often be followed by more serious freezing up from the condensed steam. It is thought that the system of steam radiators which will be installed will prevent the necessity of using live steam even from the perforated coils which are intended to be used only in case of emergency. Steam will be kept in the radiators throughout the winter months.

Ash Pit Details

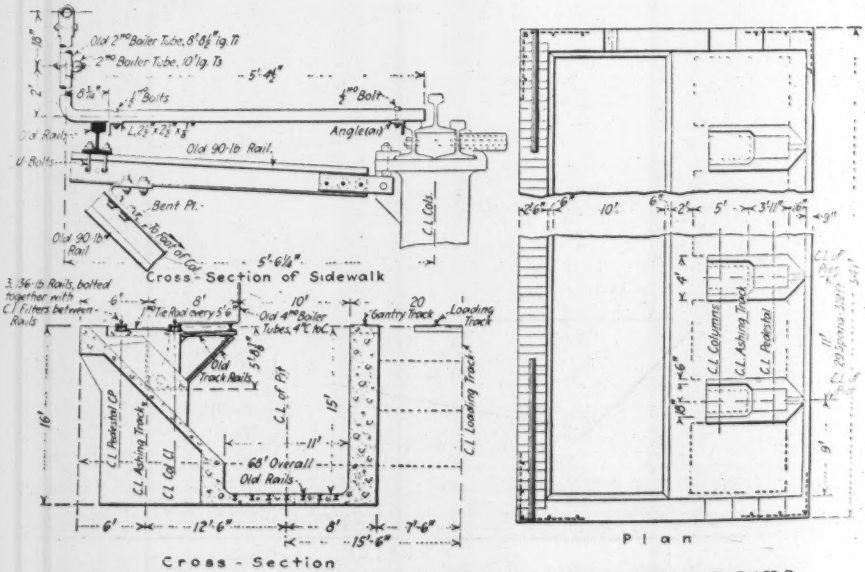
Some of the heaviest construction experienced in building the terminal was encountered in excavation for the ash pits. It was necessary to excavate in solid rock over an area approximately 70 x 350 ft. to a depth of from 18 to 20 ft. in addition to grading for adjacent tracks, the character of which is indicated in the accompanying photograph showing the ash-pit gantry crane. A drawing of the pits, which are of the water type, together with details, is shown herewith. The gantry operates on a track of 17-ft. 6-in. gage, loading from the pits with a grab bucket into cars on the center track. A feature of the ash-pit design is the use made of the materials which were cheapest and most readily available. As indicated in the drawing, the sidewalks and railings consist of old boiler tubes supported on a frame of 90-ft. steel rails connected with angle irons. The sidewalk is 5 ft. wide, extending over the pit from the inner rail of the ashing track, provided with a railing also built up of boiler tubes 3½ ft. high. Old rails were used also for the reinforcement of the floor of the pits. Ashing tracks are carried on girders built up of three 136-lb. rails bolted together and separated with cast-iron fillers, with a span of 11 ft. between pedestals and cast-iron columns. There are 29 such spans in each pit, with rail girders supported on cast-iron columns.

Work on the engine terminal has been carried out by forces of the railroad company, which originally were


Reinforcing ¼" Rods, 4" C. to C.
Cast separate and set on substructure when roof is completed
Smoke Jack Beam
Beam
Sufficient play for fill in mortar
Longitudinal Section
Cross - Section

DETAILS OF REINFORCED-CONCRETE SMOKE-JACK AND HOOD CAST WITH ROOF

organized on short notice specially for the purpose. Ground was broken about the middle of 1918 and the terminal is now nearing completion. The design and construction were carried out under the direction of G. T. Hand, chief engineer, who organized the special forces of the railroad company for the work. Construction was at first in charge of A. B. C. Scull, resident engineer, who was temporarily relieved by O. H. Kellogg, resident engineer, during his absence in military service. Designs were carried out under the immediate direction of J. J. McCleece, architect, office of chief engineer.



ASH PIT DETAILS—SIDEWALK OF OLD BOILER TUBES AND RAILS

A Leaf From Lenin's Policy on Manpower

By Frances A. Kellor
Associate Managing Director of the Inter-Racial Council, New York

A BOLSHEVIST reign in Russia is for the moment assured. Lenin's formulation of ideas plus his ability to put them into operation promise some interesting experiments in handling manpower problems. American business men will do well to set their denunciatory powers aside and to develop their analytical and critical faculties to the utmost, to understand the economic changes taking place in that country and to so profit by the lesson that similar changes may not occur in America by identical methods.

The responsibility for checking Bolshevism rests with industrial leaders, not with political leaders. The economic bulwarking of the present system of production, not the passage of laws, is the answer to Bolshevist propaganda.

Throughout the world, we have to deal with materialism—to think first of food, shelter, clothing, rewards, profits, surplus, investments, and securities. Lenin personifies the height of materialism. His program is wholly economic. He relies upon dictatorship and force to make it effective. America is not less in the grip of materialism—even though riot and bloodshed are for the time being absent. Everywhere the question is "What can I get out of it?" and "Whom can I boss?"

The question confronting industrial leadership in America is: By peaceful methods, through a genuine co-operation of men, and with the aid of science, can the various elements of human power be united on a common basis of production—a *manpower* as inclusive of management as of men? Can there be formulated the kind of manpower engineering which will compass the field and train the new leaders whom the economic world needs?

Certain as men may be that Lenin's materialism and use of force will fail, he has at his command for his experiment the greatest single supply of raw manpower ever placed under one central domination.

Lenin's Labor Rules

Franklin got electricity from the storm of the heavens and paved the way for Edison; Lenin may get from riot and bloodshed the principles that mean his own destruction—but the truth of a new science to be established under new leadership.

Lenin has laid down the principle that eight hours of work is the standard; and that during that time *nothing that is not conducive to production and cannot be measured in terms of production shall be permitted in the industry*. It is the first clear, relentless application of manpower to production on a large scale that the world has ever seen. At one stroke it abolishes both welfare measures and strikes. The introduction of any welfare or human measures, of any recreation or other social features, not necessitated solely by production will not be tolerated. He holds that the plant is no place for civics, education or semi-industrial expression. For these most ample provision should be made outside of working hours and should be assiduously encouraged.

Lenin sees more clearly the line of demarcation between the application of manpower to production and manpower running idle than is evidenced anywhere else in the world.

"Iron discipline" during work hours is the method by which he hopes to make it succeed. If it does not come voluntarily from the men, then bayonets or penalties will do as well. Lenin's own statement can hardly be improved upon:

"Economic improvement depends on higher discipline of the toilers, on higher skill, efficiency and *intensity* of labor and its better organization. Material production requires an absolute and strict unity of the will. How can we secure a strict unity of will? By subjecting the will of thousands to the will of one. This subjection of the participants in the common work, who are ideally conscientious and disciplined, may resemble the mild leading of an orchestra; or it may take the acute form of a dictatorship. But at any rate, complete submission to a single will during work is absolutely neecssary for the success of processes of work which is organized on the type of large machine industry. We must learn to combine the strong energetic breaking of all restraint on the part of the toiling masses *with iron discipline during work*, with absolute submission to the will of one person during work."

Now contrast with this the freedom of manpower Lenin recommends when it is running idle outside of the shop. The workers are to be attracted to active participation in political life, they are to have meetings and recreation without stint. Lenin says:

"Our aim is to attract every member of the poor classes to practical participation in general management [political] and the different steps leading toward this end (the more diverse the better) should be carefully registered, studied, systematized, verified on broader experience and legalized. It is our object to obtain the free performance of state obligations of every toiler after he is through with the eight-hour session of productive work."

The Situation in America

What is the lesson in this experiment to America? Despite the fact that America is the greatest machine-producing country in the world, and has tremendous industrial genius for organization, it is very far from handling its manpower in an orderly, economic way. Industrial leaders are groping for a uniting principle, and for standards and methods of operation, in this whole field.

Production is struggling in a morass. Men are at variance over what words to use in referring to workmen and to management. Some employers think it makes a difference if their men are called employees or workers, or workingmen. Capital and labor organized in different camps find it increasingly difficult to keep their separate identity, when workmen are so fast becoming investors and small land owners and stockholders. Socialists have to resort to extreme measures to keep the bitterness in class consciousness and to hold workers and management apart. The Communist understands and forgives the member who shrinks at throwing a bomb, but distrusts and expels the member who discusses industrial betterment in company with a capitalist.

Indications are fast multiplying that "welfare work" and "scientific management" are alike doomed, with nothing as yet to take their places. Each corporation,

according to the whim of its directors, experiments with the Leitch plan or the Whitely plan or the works council, and centers its hopes in such solitary panaceas.

More and more the industrial engineer is being called upon; plants are flooded with "service" schemes from aspiring Croesuses. These cover everything from plant posters to the educational spy sitting on the job alongside of the men whom he aims to educate.

While this confusion of mind and sterility of effort prevail, the waste of power goes on unchecked. It is estimated that it costs American production $30,000,000 a year just to exchange men with each other. The labor market is unorganized, each employer competing with another for the new supply of men. It is apparently no concern of industry that millions of unskilled immigrant workmen are going back home, and that laws are to be passed forbidding their return. They read with complacency about the hunting of "Reds," not realizing that every man caught in the net who is not guilty and his countrymen who are not Bolshevists and hate injustice, retaliate by striking on the job, resulting in a low morale which makes poor quality and output low.

Employers realize that something must be done, but instead of getting together and finding a way which will work for all industry, each goes off in his own little corner of the world and experiments and wastes power, proving the success or failure of what at most can be but temporary panaceas.

Engineer Holds Solution

Now is the time to bring law and order out of this confused vision and disordered effort. Nothing but science has ever been able to understand power of any kind. Engineering is the only method that holds out any promise of ultimate success. Increasingly the engineer, untrained in manpower, but having the essential ground work, is becoming the manager of men. In the next quarter of a century he will be the chief director of manpower. He is the man that will defeat Lenin, by reducing his ideas to law and order, without revolution.

The war has revealed to men that they are not anywhere near their capacity for output. It has created a demand for comforts among all men which the capacity of men will be taxed to meet. This is the problem of production. If this problem is not solved under the system of capitalism, it will be solved under some other system. It cannot be evaded.

The present concentration of labor into one group and of management into another cannot go on and get us anywhere. Already the lines are hopelessly confused and radicals and reactionaries are splitting the ranks of each wide open. Laws have proven useless as stimulants to production.

The application of manpower to production in its essence is the province of science to solve—just as much as the application of heat power and electric power to production was the province of science to solve.

The general acceptance of this idea has been delayed by the usual fumbling in any new field. The efficiency engineer conceived of it in terms of saving lost motion. The industrial engineer conceived of it in terms of patchwork—a fixing up of industrial relations. The welfare man is a kind of compromise of the employer with his conscience who thinks something should be done but not too thoroughly.

Scientific management was an imposition of theories; it was a juxtaposition of words without scientific basis or credence and was distrusted from the beginning. The trade union is a kind of armed camp from which men skirmish for advantage and position with little relation to the principles of production, and the employers' association is little better.

Long before the uniting principles in heat, power, or electrical power were found, so much as man could discover and use was applied to increase production and to secure comforts. It was a long way from the discovery to the formulation of the science.

There is similarly to be a long line of discoveries and of experiments in manpower, which parallel, though they are not identical with, those of other kinds of power. Marx believed the final answer to be Socialism. Lenin thinks he has found it in Communism. Gompers thinks it is in the trades unions. These are but passing movements which will eventually contribute their share to give the world a science of manpower.

The American inventive mind does not tolerate chaos and waste in other forms of power. The best minds and knowledge of engineering would be put to work in laboratories and shops to find a remedy for leaks in steam and electrical power. They would be the subject of scientific inquiry and of discussion.

Not so with manpower. The subject is approached from the position of capital or of labor. Men's minds are impelled toward it to right wrongs or to earn rewards—or to propound theories and to ride hobbies.

When we speak of the civil or the mechanical or electrical or chemical engineer we know he has had certain preliminary training and that there is a language in which we can talk to him which we both understand. He knows certain preliminary things that we do not have to bother about. When an engineer is engaged to design and build a bridge, the contractor has certain definite things to rely upon, and the engineer's reputation is the application of his knowledge, experience and initiative in a highly competitive world which stimulates him into perfection in his occupation.

Varied as are the courses for engineers, there are certain uniform fundamentals that give them mental integrity and an operation of mind highly essential to handling his subject matter.

What of the men who handle manpower? Call them together and see what is to be found in any miscellaneous group. Here is the engineer with training; beside him is the foreman promoted because he got results—often with his fists. Across the room is the secretary loaned by an organization interested in saving souls and his neighbor is an efficiency engineer. From whatever walks of life they finally arrive at handling manpower, their training is incongruous; it is everything from the grammar school to the medical college, plus industrial experience or minus it, as the case may be.

Not less interesting than the equipment of "personnel" men, are their duties. It is anywhere from the simple one of running a lunch room or conducting a class in English to handling all of the functions of an up-to-date employment department or a works council. The scope of his duties may be governed by an enlightened general manager or a foreman opposed to all changes.

The problems of power are the same, whether it is to be extracted from men or from materials. How to get power units requires knowledge and organization. With manpower it is men; with heat and electricity it is mate-

rials. How to use power requiring management, how to increase power from existing units, requires research and experiment. Not so many years ago, the problems of electrical power and its application seemed not more difficult and variable than are those of manpower today. Scientists obtained the secret and put it to practical use and reduced their findings to engineering terms. Scientists will find the secret of manpower just as soon as they set about it in the spirit of attaining knowledge and its practical application.

How to get power units is the problem of the labor market, and its organization. There must be fundamental principles which can be discovered and laws that can be applied; their discovery and formulation is but a matter of time. How to use this power concerns itself with the treatment of men and the conditions of work. There are as definite principles and methods that govern this field as exist in any other field of power, but we do not know them yet. How to increase manpower from existing units concerns itself with incentive. rewards, and participation in management.

Lenin hopes to discover these secrets by the use of force through communistic organization. The country that makes the discoveries and reduces them to operating terms by the use of science through a democracy in which all men—hand and brain workers alike are recognized—will be the master of production.

An analysis of any one hundred American plants struggling with shortage of labor, leaks in power, and losses in power that defy methods being installed to produce power, shows no agreement in theory or operation upon the elemental factors, which may be put as follows:

1. *Certainty of employment*, which gives the stability of power.
2. *Incentives and rewards*, which give the volume of power.
3. *Treatment and working conditions*, which give the intensity of power.
4. *Participation in management*, which releases unused and undeveloped forms of power.

Not only is there no agreement on the theory or method of operation of these elemental factors, but we have failed even to use our discoveries. In the rush of the war, the varying grades of productivity in plants was found to be a detterent in winning the war. The crude method of distributing skilled workers in plants of low output was adopted and caused the delusion of labor. With the close of the war, much of the co-operative elements incident to the war disappeared, and with it even glimmers of the intelligent handling of manpower. We are back where we started, fighting along class lines.

The Remedy

What is the remedy?

First of all, it is a slow one—which will not appeal greatly to the impatient American producer.

Second, it is not an emergency measure, and cannot be handled as a campaign or a drive, or a panacea.

Third, it is not a lot of disjointed efforts into which men may be stampeded through a fear of Bolshevism or of anything else.

Fourth, it is not a defensive negative remedy, but a constructive positive remedy.

Fifth, manpower is no longer to be regarded as an individual-plant problem to be dealt with according to local plant ideas any more than is electric or heat power to be applied irrespective of governing principles and methods.

Sixth, manpower is not to be fully handled by the setting up of elaborate government machinery to deal with its outbursts and disagreements.

There is required *first of all* a scientific inquiry into the application of manpower to production, which shall be free of all imputation of bias toward either capital or labor. Analysis must replace propaganda. Such an inquiry as a basis for the adoption of principles and standards and formulations must precede the introduction of any courses for the training of men and must cover as essentials certainty of employment, incentives and rewards, treatment and working conditions, and participation in management.

With such data in hand, we can begin to see what things belong in the plant as 8-hour production measures and what belong to the community as 16 hours free time. Nothing is more important to the plant than that there should be clear governing principles upon plant matters as distinguished from community matters.

To go on making recreation and hospitals, and lunch rooms and lectures and dances, and baseball teams and concerts, plant activities without definite relation to production, is to write disaster. It invites it because their introduction causes suspicion and resentment, sarcasm and misunderstanding.

To go on saddling the community with obligations which are the result of misapplication of manpower in production is to invite legislation and investigation and inspection and other outside interferences, which hamper the determination of scientific principles and methods in the application of manpower.

To continue in plants outside uplift agencies, knowing little or nothing about production, and to introduce temporary expedients—not an organized part of industrial organization—is certain to be disastrous.

Organization of Data

There is data in abundance; there are experiments in profusion. The present method of collating them is for an investigator to make a study and write a book or deliver a lecture. There is an endless procession of books and lectures. This procession is now being succeeded by an endless variety of industrial and human engineers. Not any one line of data, not any one set of experiments or of theories of the various engineers is submitted to the tests required of any other form of power before it is applied. A manpower experiment tried out in one plant is no more ready for general recommendation as fundamentally sound for all industry to adopt than is an experiment in the field of mechanical power. Perfection, secured by a variety of tests, is as important in one field as in the other.

There is an almost complete absence of any such conception of manpower and its application.

What one incentive or record can be counted on to produce maximum power in every plant where it is applied?

Do any two employers agree upon the amount of power produced by profit-sharing, and what type gets most power?

Do any two plants follow the same system of assuring certainty of employment and is there any one accepted method which keeps the human equipment up to a given percentage of perfection?

What part do ventilation and heat and light play in

working conditions to intensify power, and are they standardized in marketable shape so other plants can adopt them?

Conference after conference, congress after congress, meets to discuss markets, raw materials, prices, etc., and are silent on manpower—the application of which to production is the biggest single unsolved scientific problem in the world today.

There are many treatises on the subject of labor, but who knows whether they are any good? Someone makes a discovery in electricity. It is immediately reduced to operating terms or it is discarded. Someone writes a book on civil engineering. Ten thousand engineers pounce upon it, read it, apply their experience and knowledge and it becomes a textbook, or a general reference book, or it is soon covered with dust. The point is, these engineers are interested in maintaining the standing of their profession, of protecting the integrity of their science, of establishing standards of learning and of efficiency.

With manpower it is different. Someone gives a thrilling account of the works council. Without finding out about it or its principles of operation, or its relation to the whole scheme of handling men, hundreds of plants install it and then wait for the millennium. One plant has success with a profit-sharing scheme and then another plant, adding here and there a little individual touch to satisfy its local pride, initiates something that gets a poor return on its investment. Result, the idea of profit sharing becomes the subject of controversy in which few facts and fewer tests appear and each defends his own pet scheme.

These pages could be filled with illustrations of haphazard schemes installed in such disjointed ways. There is no central authority—because there is no science and no professional pride to preserve it, to which the industrial leader desirous of measuring up to his obligations can turn for enlightenment and be sure he is getting disinterested information and tested experiments. Why should not the Works Council or the bonus system or any other form of generator be subjected to as rigid tests as a new design of steam engine? Both are designed for one purpose—power generators to increase production. Defective co-operative management is likely to prove much more destructive than a defective steam engine. In the one case we permit any theorist, with little training and less reputation, to submit a design which is often adopted untested; in the other case, we ask for a guarantee unless the trade mark constitutes one.

How Get the Data

Shall we get the science or the engineer first? Once industrial leaders are convinced that manpower is an engineering job and that the efficiency of the present system of production depends largely upon the engineer, they will come together, and begin to work out the fundamental principles and methods of operation and will begin to ask for trained men.

The engineering colleges are awakening to the coming demand, but they, too, are doing patchwork and have not grasped the idea that the application of manpower to production is a science and that they may take a big lead in its formulation and ultimate operation. Most of the courses are still couched in terms of management rather than in terms of manpower.

Coincident, therefore, with analysis of a collation and rigid existing data there should go an analysis of existing training courses and the formulation of manpower engineering courses that will meet the growing demand for trained men.

America senses but dimly as yet the demand that will be made upon its engineers by foreign countries. They will be called upon to handle manpower and to settle finance questions for which they have little preliminary training or basic judgment. American industries will be hard put to find substitutes for these men. The answer is the manpower engineer trained as thoroughly and as fast as American institutions can do it. The country that produces this kind of engineer will control the resources of the world.

Let us have the engineer, through the Engineering Council and the Engineering Division of the National Research Council undertake a thorough scientific research of the problems of manpower.

Let us follow this article by formulation of the essentials of the science and by a definition of its operations.

Let us have a manpower research center as free from self-interested control as any physical laboratory in America.

Let us outline practical courses in engineering colleges to meet the demand for trained men.

Let us take a leaf out of Lenin's policy of applying manpower eight hours a day relentlessly to the job, cutting out the camouflage and fog, and make Bolshevism impossible in America through revolution because American industrial leadership has believed in and solved the problem through evolution.

Shallow Pit Coaling Station for the Chesapeake & Ohio R.R.

Ground Water at 12 Ft. Below Subgrade Was a Governing Factor in Design—Operation of Loader Mechanism

GROUND water in large quantities at about 12 ft. below subgrade level was a governing factor in the selection of the type of coaling station built recently for the Chesapeake & Ohio R.R. at Handley, W. Va. For the usual gravity feed from a track hopper to the elevator a track pit about 26 ft. deep is required, which in this case would have involved costly wet excavation and a continual operating expense for pumping. In the adopted design the pit is only 12 ft. deep, the coal being fed to a mechanical loader which charges the 2½-ton elevator bucket. The roadbed will be widened for a third track on the right outside of the columns of the coal bin.

Figs. 1 and 2 show the general design of the coaling station and details of loader mechanism.

The shallow track pit is divided into two sections, the upper being the hopper to receive coal dumped from cars and the lower one containing the loader machinery. A steel discharge chute in the bottom of the hopper is closed normally by a gate which travels on wheels on an inclined track and is held in the closed position by a chain and counterweight. A truck or loader of 2½ tons capacity travels on another inclined track and is operated by an endless chain. When the empty loader runs down its incline it drives back the rolling gate, so that coal flows through the chute until

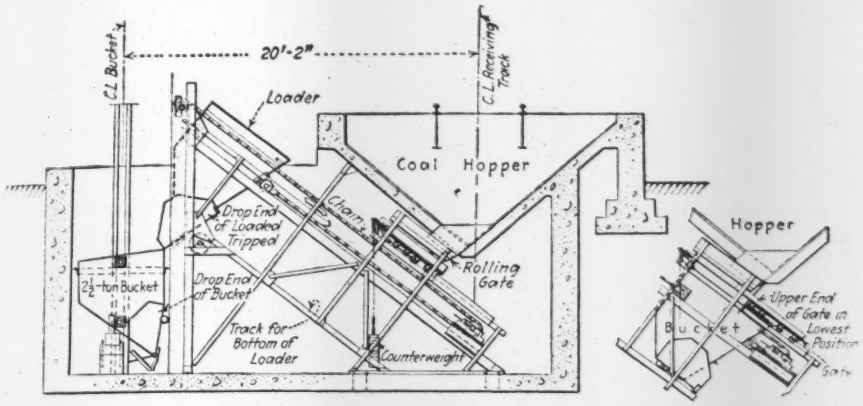


FIG. 1. COAL-LOADING DEVICE REQUIRES TRACK PIT ONLY 12 FT. DEEP

the loader is full. At this instant the driving chain is started and moves the loader forward, while the gate follows it and closes the chute.

As the loader reaches the head of the incline its bottom section is tripped and falls forward to form a chute through which the coal flows into the elevator bucket. This bucket is then raised to the top of the steel tower, where its bottom gate is tripped, discharging the coal into a chute which enters the roof of the elevated bin. The bucket makes a round trip in about 1½ min. An electric motor of 22 hp. operates both the loader and the bucket, the two sets of mechanism being cut in and out automatically to provide for the series of intermittent movements of both devices. As the loader is connected to the hoist by spur gears the timing of the operations remains constant. This plant has a capacity for handling 75 tons of coal per hour. For a capacity up to 150 tons similar plants have two balanced buckets and two loaders.

A 500-ton bin of reinforced concrete spans the engine tracks and has its bottom sloped 40 deg. from the center to the sides. Provision is made for side spouts to serve a third engine track on the right, as shown in the plan. To supply two grades of coal, the bin is divided into two compartments, one for 333 tons of screened coal for road engines having mechanical stokers and the other for 167 tons of run-of-mine coal for road and yard engines. The chute from the head of the elevator tower has a forked end and is fitted with a gate to divert the coal to either of the compartments, as desired.

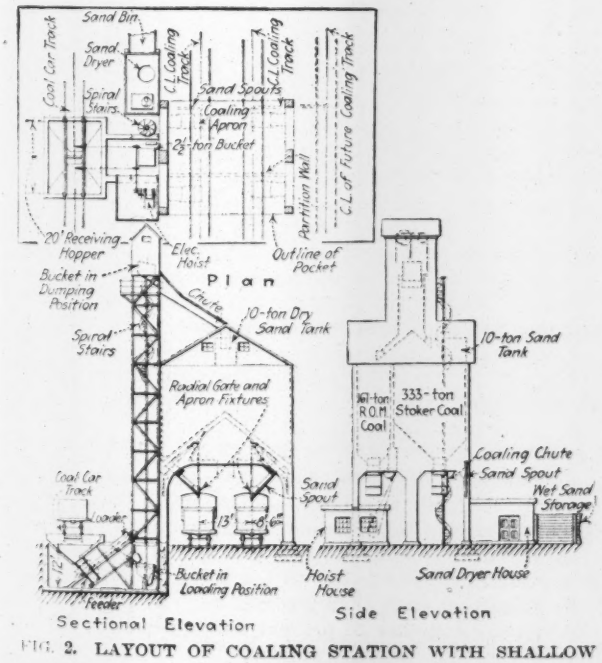


FIG. 2. LAYOUT OF COALING STATION WITH SHALLOW TRACK PIT

Adjacent to the coaling station is a sand-drying house and 100-ton sand bin. Dried sand is delivered to a drum, from which it is blown by compressed air through 3-in. pipes to a 10-ton tank under the roof of the coal bin. From this tank, the dry sand flows by gravity through 3½-in. pipes to hinged spouts which may be lowered to the engines. The pipes are fitted with moisture-proof undercut sand valves.

From 40 to 50 engines are coaled daily at this point. This coaling station was designed and built in 1919 by the Roberts & Schaefer Co., Chicago. The work was under the direction of F. I. Cabell, chief engineer of the Chesapeake & Ohio R.R., with H. L. Vandament as resident engineer in charge.

Wyoming Seeks Co-operation from Road Contractors

In a circular letter to Wyoming contractors D. C. McCalman, superintendent Wyoming State Highway Department, seeks co-operation by announcing that:

Every contractor as soon as he is awarded a contract by the State Highway Commission should be considered a unit in our organization. Many engineers in charge of construction work are inclined to be antagonistic to contractors doing work and possibly some members of our engineering department have in the past taken this attitude. They are now, however, instructed that contractors doing work for Wyoming are to be considered a unit in the organization, and they are to endeavor at all times to help complete the work promptly, economically, and in accordance with plans and specifications.

The phrase "according to plans" is not, however, to be a hard and fast rule and contractors should not hesitate to take up with district engineers any change in plans considered advisable. All contractors were recently requested to furnish this department certain information we desire to file in the shape of card index, so that in awarding contracts we may give due consideration to past performance and financial responsibility as well as the unit prices bid. In this connection contractors will be required on future awards to show they have a cash working capital in the amount of 20 per cent of the total contract. Effective at once contracts will be drawn so that contractors will be allowed on monthly estimates the value of materials delivered in advance of time required. Also contractors will be allowed on monthly estimates the premium paid for surety bonds as evidenced by receipt for same.

Twenty Years of Reinforced-Concrete Railway Ties*

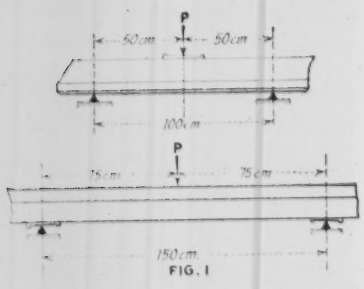
Review of Experiments and Experience in the United States and Foreign Countries — Results Largely Inconclusive and Unfavorable — Tests Continue — Principal Types

By Cyril H. Wakefield
Assistant Engineer, Office of Consulting Engineer, Southern Pacific Co., New York

REINFORCED-CONCRETE ties for railroad track cannot be, said to have progressed beyond an experimental stage, since they are used only to a very limited extent, and in order to compare economically with wooden ties they will have to show a life of at least 30 years. Except for a statement of doubtful authenticity that such ties have been used in Mexico for 31 years, the records indicate that the first experiments were made in Germany 22 years ago and have been continued on a small scale. Italy, however, has been the real leader, having laid over 300,000 ties during nineteen years. The French railways in Indo-China started experiments twenty years ago and had about a million ties in use at the end of ten years. France has been conducting experiments for nineteen years; England for eleven years, Switzerland and Sweden for about ten years and Denmark for eight years.

Experiments in the United States began 20 years ago and about 20,000 ties have been placed in service. Their results are of greater value to the railroads of this country than are those of the foreign experiments, for European wheel loads are considerable lighter than those of American railways and traffic conditions are less severe. Unfortunately, however, many of the records are far from complete. Since 1907 the American Railway Engineering Association has obtained much valuable information on the subject, but many of the reports are incomplete.

It is the purpose of this article to present in compact form the available information on the subject of reinforced-concrete ties as regards their design, their use and the practical results obtained. It is based upon an extensive report prepared by the writer for John D. Isaacs, consulting engineer Southern Pacific Co.



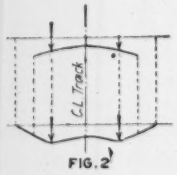


Fig. 1—Relation of length of tie to deflection under load.
Fig. 2—Loading tests for Italian ties

Experience has shown that the design of a satisfactory reinforced-concrete tie is a problem requiring considerable thought and study. As concrete has not the resilience of wood, it is essential that all the elements affecting the elastic action of a transverse tie shall be given consideration in designing a suitable substitute for the wood tie.

The elasticity of a tie depends upon its length, its stiffness and the nature of the ballast. A tie which is too short shows its maximum curvature at the center, while a tie of correct length becomes most bent under the rails. This is shown in Fig. 1. A flexible tie bends and gives high pressures on the ballast directly under the rails, while a stiff tie shows less bending and distributes the pressure more uniformly upon the ballast. Hence, ties made of material which possesses comparatively little flexibility, such as reinforced concrete, should be made as stiff as possible. In other words, they should have a large moment of inertia.

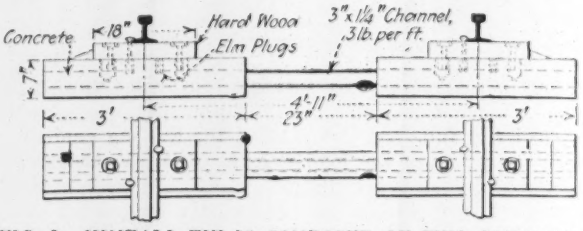


FIG. 3. KIMBALL TIE IS COMPOSED OF TWO CONCRETE BLOCKS CONNECTED BY STEEL CHANNELS

It has been pointed out by G. H. Kimball, the inventor of a divided tie, that in ordinary track construction the pressure on ties is eccentric. The ties extend about 18 in. outside of and 30 in. inside of the center of each rail, and as they present more bearing surface inside of the rail they tend to settle unequally. In other words, the center of pressure and the center of figure of the bearing surface do not coincide. For this reason the ends of the ties are more or less loose in the ballast, except when under load. A reinforced-concrete tie should be designed to act as a cantilever beam and thus withstand the severe shocks occasioned by the sinking of the ends of the tie under passing loads on a center-bound track.

It is essential that reinforcement be placed near the surface of all parts subjected to tensile stresses under various conditions of loading. With ties of the correct length tension will occur in the top at the middle, and in the bottom beneath the rails. Outside of the rails there may be tension in either top or bottom, depending upon roadbed conditions. Reinforcement in the center of the cross-section is useless, for it does not aid in resisting any tensile stresses. In general, the design of a satisfactory reinforced-concrete tie should meet the following requirements, which are based upon theory and the results of practical experience:

1. Sufficient area of bearing surface upon the ballast to transmit safely to the roadbed the weight and impact of the applied loads.

2. Sufficient frictional resistance in the ballast to prevent lateral movement of the track.

3. Sufficient strength, elasticity and endurance to render satisfactory service under traffic conditions, including ability to withstand derailments.

4. Ability to maintain gage of rails and to hold them in a position perpendicular to the plane of the track.

5. A section such that the ties may be placed sufficiently close together to prevent any appreciable deflection of the rails between supports.

*Based upon an extensive report, prepared by the author for J. D. Isaacs, consulting engineer Southern Pacific Co., New York.

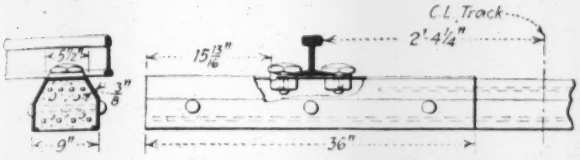


FIG. 4. ATWOOD TIE HAS TWO STEEL BOXES EMBEDDED IN CONCRETE

6. An efficient method of fastening the rails, the attachments being simple and accessible for adjustment or repair.

7. Provision for proper insulation. Concrete is almost an insulating material, but care must be taken to prevent contact through the metal reinforcement. A non-insulated tie should be capable of being insulated without having to be removed from the track.

8. Cushion blocks, if used, should be removable.

9. For facility of maintenance, the tie should be of such form and section as will permit the ballast to be properly tamped beneath it, thereby aiding in preserving the alignment and surface of the track.

Application of Engineering Knowledge

Although little reliable information is available as to the behavior of the Maciachini (Italian) ties in actual practice, it is interesting to note the sequence of five designs. The results obtained led to a continual increase in the moment of inertia, first by strengthening the reinforcement and then by increasing the cross-sectional area of the concrete. It was found to be more advantageous to replace the many small roads, which were at first distributed over the entire cross-section, by a less number of larger rods placed nearer the boundary of the cross-section.

It was found necessary to test the strength of every tie, without exception, before putting it in service, the most essential test being that which dealt with the negative bending moment at the middle of the tie. The strength tests proposed by Mr. Maciachini, as shown in Fig. 2, represent the forces acting upon the tie when in use: (1) A load of 2,000 kg. (4,410 lb.) applied at the rail seat; (2) a load of 1,200 kg. (2,645 lb.) applied midway between the rail seats, with the tie inverted and supported as shown.

In this country, Mr. Kimball was the first to recognize the importance of making provision for the tensile stresses in the top of the tie between the rails, and he met the situation in a novel way. Instead of making a full-length tie he used a pair of concrete blocks, each about 3 ft. long, connected by a piece of scrap rail or

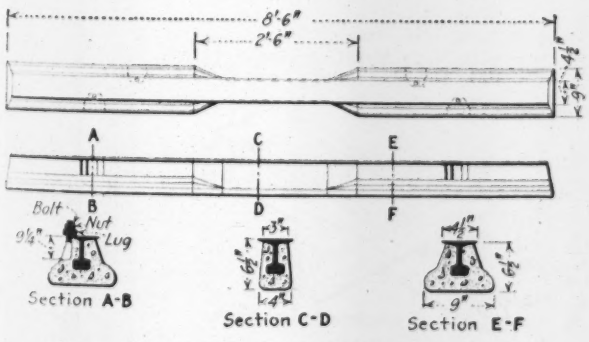


FIG. 5. BUHRER TIE RELIES ON OLD RAIL FOR STRENGTH

a pair of light steel channels. The blocks are placed symmetrically under each rail so that the center of pressure and the center of figure of the ties coincide and thus the most destructive stress in the tie is eliminated. A number of later ties have been patterned along similar lines, with good results, in most cases, as compared with those shown by full-length ties.

In various ties, especially of the earlier types, some of the essential principles in design were disregarded. The Percival tie, which tapers to a wedge shape in the middle in order to give stability, has insufficient bearing area; the Affleck, Campbell, Hickey and Leopoldina Ry. ties have the reinforcement in the middle of the cross-section; the Bowman and the Ulster & Delaware R.R. ties have no reinforcement at the bottom beneath the rails, while in the MacMartin tie this is lacking at the top between the rails.

On the other hand, the Indestructible, MacDonald and Stoneback ties in America, the Hall and the Jagger ties

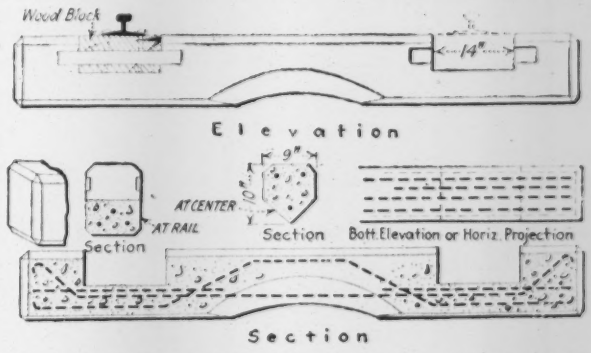


FIG. 6. THE "INDESTRUCTIBLE" TIE IS A REINFORCED-CONCRETE BEAM

in England, the Asbeston and the Voiron-St. Beron Ry. ties in France, the Asbeston and the Dyckerhoff-Widmann ties in Germany and the Maciachini (type 4) tie in Italy, are all examples of full-length ties in which the reinforcement has been arranged with due regard for the location of tensile stresses.

Classification of Concrete Ties

Space will not permit of detailed descriptions of the various designs. Some of the more notable have been described, as follows: *Engineering News*: April 3 and Aug. 28, 1902 Kimball; July 7, 1904, Voiron-St. Beron Ry; Oct. 6, 1904, Ulster & Delaware R.R.; Aug. 17, 1905, Buhrer; Oct. 5, 1905, Campbell and Percival; Sept. 30, 1909, Jagger and Chenoweth; Feb. 17, 1910, Reigler; March 15, 1917, Wolf. *Engineering Record*: Aug. 19, 1905 (supp.), Percival; Nov. 25, 1905 (supp.), Chenoweth. (See also the published volumes of "Index to Engineering News.") There are about seventy designs, half of which are of American origin. In general they may be classified under the following four main types:

1. A divided tie consisting of a pair of blocks connected by some form of steel bar or truss.

2. A full-length tie in which the steel withstands practically all of the stress, the concrete being more or less incidental and serving either as a filler for the metal portion of the tie or as a means of distributing the load over a sufficient area of ballast.

3. A full-length tie wherein the reinforcement is wholly surrounded by concrete and is so distributed as

to assist materially in resisting tension in those parts of the concrete subject to tensile stresses.

4. A hollow or cored tie consisting of a shell of concrete reinforced to resist tensile stresses.

Description of Concrete Ties

The Kimball tie, the Atwood tie (or the Buhrer tie), the Indestructible tie and the Wolf tie are representative of these four main types respectively, and may be described a little more in detail.

Kimball Tie—This consists of two concrete blocks 9 in. wide, 7 in. deep and 3 ft. long, the sides being convex. These are connected by a pair of 3-in. steel channels set back to back and extending under the rails to within 1 in. of the ends of the blocks. The exposed surface of the channels is protected by two coats of portland cement mortar and the space between them is filled with concrete. Hardwood cushion blocks, 3 x 9 x 18 in., are secured by ½-in. tap bolts screwed into anchors embedded in the concrete. The rails are held by ordinary track spikes driven through the wood blocks into hollow elm spiking embedded in the concrete. Each concrete block has a lug across the top to afford lateral support for the cushion. With stone concrete, the proportions are 6 : 11 : 3, using 1½-in. broken stone. Gravel concrete is a 2 : 1 : 3 mix, using ¾-in. clean bank gravel. The weight of the tie complete is 436 lb.

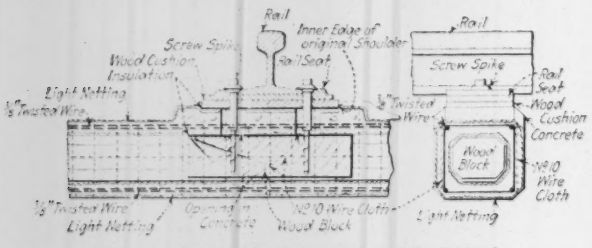


FIG. 7. WOLF TIE IS A HOLLOW BEAM

Atwood Tie—This consists of two steel boxes of ⅜-in. metal, each centrally located under a rail, the boxes being 5½ in. wide at the top, 9 in. at the bottom, 8 in. deep and 3½ ft. long. They are filled with and connected by reinforced concrete, the total length of the tie being about 8 ft. 5 in. The reinforcement consists of four square steel bars in the top and four in the bottom. The concrete is not required to act as a beam, as the two steel boxes are of sufficient strength to support the wheel loads, but it gives ample load-distributing surface to the ballast. The tie is insulated, as the top reinforcing bars do not extend under the rails, thus eliminating any contact between the bars and the 1½-in. bolts which hold the rails.

Buhrer Tie—In this design a piece of 65-lb. or 80-lb. scrap rail is used, inverted, with its head and web embedded in concrete. The concrete is massed toward the ends of the tie, which is 8 ft. 6 in. long at the bottom, so as to give a supporting base 7 in. to 9 in. wide for 3 ft. from each end. At the center the base is 3 in. to 4 in. wide, while the depth of the tie is 6½ in. throughout. The flange of the inverted rail forms a seat for the track rail and an attachment for the fastening, which consists of a clamp, a nut and a ¾-in. bolt. Some ties are of gravel concrete, 1 to 4. Others have one part cement, one part fine washed limestone and three parts ½-in. washed limestone. The weight of the tie with an 80-lb. rail is 460 lb.

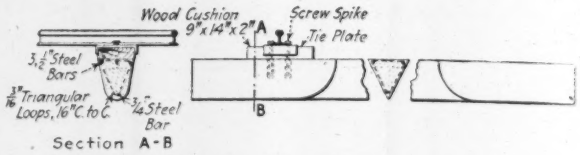


FIG. 8. PERCIVAL TIE

Indestructible Tie—This is 9 in. wide, 12 in. deep and 8 ft. long, with all edges and corners bevelled. At the center, the bottom is hollowed out for a depth of 2 in. and the sides are sloped down to a wedge shape, thus providing a grip in the ballast. The reinforcement consists of five steel rods located as follows: One long ½-in. round rod 4½ in. from the bottom of the tie, except that at the ends it is bent up and hooked; two long ⅜-in. round rods, hooked up at the ends, placed 2 in. from the bottom of the tie underneath the rails but bent up to a like distance from the top of the tie at its middle; a short straight ⅜-in. round rod at each end, 4½ in. from the bottom. Beneath each rail the tie is recessed to receive a wood block 6 x 8 x 14 in. on each side of which is a steel plate ⅜ x 2½ x 21 in. The plates fit into grooves in the concrete and are secured by two ⅜-in. bolts. The rail rests upon the wood and is held by clips or screws. The concrete is made with gravel and the weight of the tie complete is 660 lb.

Wolf Tie—This is a hollow tie 8 in. wide, 7 in. deep and 8 ft. 6 in. long, the outward shape being similar to that of a wood tie. The walls are 1½ in. thick, increased to 2 in. under the rail seats, although some ties have a 2-in. wall throughout. The reinforcement consists of four longitudinal ⅜-in. twisted steel rods, one near each corner, around which is wrapped No. 10 wire cloth having a mesh 2 x 4 in. In addition, light netting of 1½-in. mesh is placed near the outer and inner surfaces. The rail rests upon a steel plate on a spruce cushion block 1 x 8 x 12 in., abutting against a 1-in. shoulder on the tie. The rail fastenings are free from the tie structure, the screw spikes passing through openings in the rail seats into a wood block 18 in. long inserted loosely within the tie. The average concrete mixture is 1 : 2 : 3 and the weight of the tie is 320 lb.

A classification, under the four main types already described, of the various designs of reinforced-concrete ties, is given in the accompanying list, the weights being given when known.

Type 1. American. Bates (450 lb.); Corell, Kimball (436 lb.); K. C. & H.; Western.
Danish. Jensen & Schumacher.
English. Green & Moore; Meyrick; Northeastern Ry. (Plans B, D, D[a]); R.-P. & T.; Victoria; Yokeblock.

Type 2. American. Atwood; Buhrer (460 lb.); Champion (600 lb.); Mershon (400 lb.); Riegler (800 to 850 lb.); Simplex (350 to 370 lb.); United States.

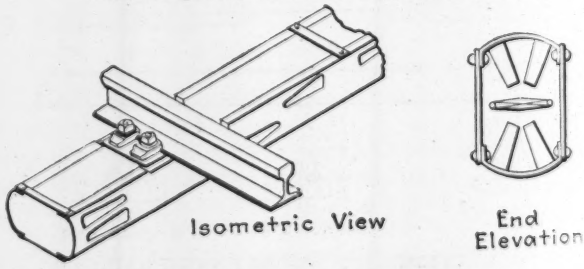


FIG. 9. RIEGLER TIE HAS STEEL SHELL

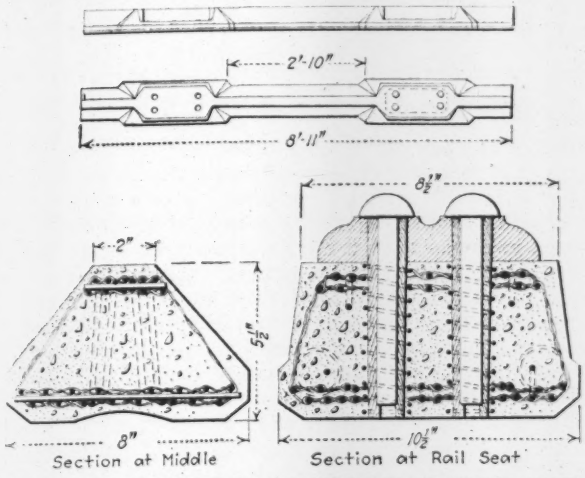


FIG. 10. JAGGER TIE IS REINFORCED BY WIRE MESH AND SMALL RODS

Type 3. American. Affleck; Bowman; Brukner (345 lb.); Brunson; Burbank; Campbell (356 lb.); Chenoweth (300 lb.); Colorado & Southern; Harrell (300 lb.); Hickey; Indestructible (660 lb.); Keefer; MacMartin; McDonald; Percival (445 lb.); Stoneback (580 lb.); Ulster & Delaware R.R. (450 lb.); Waples (1,000 lb.); Weber.
Brazilian. Leopoldina Ry. (267 lb.).
English. A. P. C. Co.; Hall; Jagger; Northeastern Ry. (Plan C) (365 lb.).
French. Asbeston; Indo-China; Sardar (308 lb.); Voiron-St. Baron Ry. (232 lb.).
German. Asbeston (397 lb.); Bavarian; Dyckerhoff & Widman (386 lb.); State Ry.
Italian. Maciachini (type 1) 287 lb.); types 2, 3, 4, 5).
Swiss. Hintermann.

Type 4. American. Leonard (600 lb.); Wolf (320 lb.).
English. Auden; Marriott; Northeastern Ry. (Plan A); Rings.

Bolts and clips, screw spikes and ordinary drive spikes are the most common means of fastening the rails to the ties, the bolts in most cases being inserted from the bottom. Spikes are driven either into wood blocks or through the blocks and into wood or soft metal dowels embedded in the concrete. In the Asbeston tie, the concrete at the rail seat is made with asbestos and can be bored like wood for the screw spikes.

Clips of various forms have been introduced in combination with bolts, screws or spikes. They show a tendency to work loose, while the heads of bolts sometimes turn so as to prevent tightening of the nuts. Spiking appears to be the most effective form of fastening.

Portland cement is used in practically all the American ties. The fine aggregate consists of sand usually, while the coarse aggregate may be either crushed gravel or crushed stone (limestone being recommended in a number of the designs), although slab has been used in a few instances. In general, the size of the coarse aggregate ranges between ½ in. and ¾ in., but 1-in. and 1½-in. stone are used in the Percival and the Kimball ties respectively. The usual proportions are 1 part cement to 4 or 5 parts aggregate, a 1:2:3 mixture being quite common. With concrete properly mixed and set, its composition does not seem to have any appreciable effect upon the strength and durability of the tie.

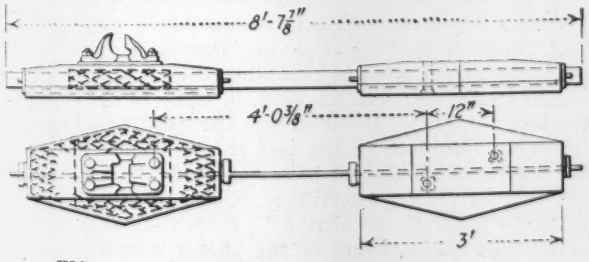


FIG. 11. CONCRETE TIE OF NORTHEASTERN RAILWAY (ENGLAND)

While space does not permit a tabulation of the records of service upon which subsequent conclusions are based, it may be said that many of the records are incomplete. It is apparent that trials of ties in small lots (a dozen ties or less) are not likely to give results of much value, but it is doubtful if the general average would be greatly affected by such experiments.

The records show that about 19,000 ties have been laid in track in this country. Italy has installed 303,000 ties; Sweden more than 2,000; England more than 400, and France more than 300 ties. The Danish, German, Swiss and Mexican records are too incomplete to permit of even approximating the numbers.

About 18 per cent of the American ties are reported to have been removed because of failure, but this figure would be increased considerably if complete records could be obtained. The relative character of failure may be represented by the following proportions: Completely broken, 14.5 per cent; disintegrated, 2.5 per cent; cracked, rail cut and minor injuries, 1 per cent. The failures of foreign ties are proportionately lower than in this country, due largely to the lighter wheel loads.

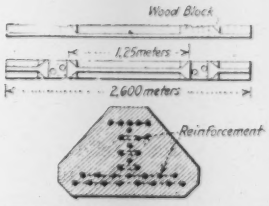


FIG. 12. MACIACHINI TIE

The most promising results have been obtained from ties of the Atwood or Buhrer tppe, in which the steel component is in itself sufficiently rigid to withstand the wear and tear; or from those of the Kimball type in which concrete blocks are tied together by a comparatively light member.

Judging from results thus far obtained it is evident that a truly successful reinforced-concrete tie is yet to be obtained. Suitable rail fastenings are as essential as the design of the tie. The load on the average track is not transmitted over the whole tie but is confined to an area extending about 15 in. on either side of each rail, while often there is an upward thrust at the center of the tie. As the ballast yields and may not provide uniformity of support, there is a tendency to flexing. This can be withstood very well by wood, but in the case of reinforced concrete it will result eventually in the concrete breaking away from the metal. Results have shown that it is extremely difficult to obtain sufficient bonding between the concrete and the steel to withstand severe service under heavy traffic.

In 1908, the tie committee of the American Railway Engineering Association took up the matter of metal and composite ties. Its report for 1909 stated that no form of reinforced-concrete tie suitable for heavy and high-speed traffic had been devised, but that such tie, with suitable fastenings, might be economical under low-speed traffic and where conditions are particularly

adverse to the life of wood or metal ties. In 1912 the committee reported that it was neither desirable nor economical to attempt to meet all the conditions with a single design, but that there should be at least two designs or types, one for heavy traffic and the other for light traffic, both insulated or non-insulated as desired.

Impressions Here and There

Intelligence in Buying—Not being a resident of Chicago, we do not know Joe Beeson, but from an advertisement that he published in the Chicago *Tribune* recently we should say that he is a man of much common sense. Incidentally, his advertisement talks about a clothing business conducted under the name of the Joe Beeson Co., but that in which we are interested are his views on the present era of high prices. Among the nuggets which one finds in his advertisement are the following:

"Put on the brakes."

"Get out of the habit of thinking, 'I must pay more and more every day.'"

"A philosopher once said, 'Human beings can get used to any situation within two weeks.' Maybe that is what is wrong with us."

If our observation is not amiss, too, Joe's fellow citizens of Chicago particularly need talking to in this strain. Extravagance is rife—yes, terrifying—in every part of the country, but in our travels east of the Mississippi we have struck no city where the evidences of extravagance showed more on the surface than in Chicago.

While all prices are higher than they were before the war, we believe Joe is right in saying that we have gotten used to the high prices, and have acquired the habit of thinking that we must pay more every day. If more of us had a fighting instinct and instead of paying $17 for the first pair of shoes the salesman showed us, would insist upon his bringing out the $10 variety, the merchant would soon begin to change his point of view and send orders back to the factory for a larger stock of $10 goods. We know some men with nerve equal to that of any retail clerk, who have gone into the high-priced shops on Fifth Ave., New York, and walked out with goods that the salesmen at first protested they did not have in stock.

We are acquiescing too easily to high prices. If we will fight, if we will "put on the brakes," if we will let the merchants know that we will buy none but more reasonably priced goods, a change for the better will set in.

This is not engineering subject—but our observation is that the subject has some interest for the engineer.

Let's be intelligent, not acquiescent, buyers.

Romance of Advertisement—Has anyone observed what a full history of engineering may be found in the advertisement pages of old technical newspapers? There we may read of the birth and growth of inventions, and divine the period of their decay and death; there we may watch the coming of new men, witness their progress and wonder why, of a sudden, their names disappear and are no more seen. Or, again, we may study the life history of companies, noting their little beginnings, their advance to maturity and their alliances, finding pleasure in pondering upon the changes in their styles and titles, now picturing the festivities when the eldest son is welcomed by his father and his father's friends to partnership, and now recalling, with mellowed regret, the passing of an old familiar name, swept aside in the triumphal march of the Goddess Progress, who knows neither sentiment nor pity. . . . The editorial pages have less intimate history in them. They are full of first chapters, odd leaves here and there from later chapters, and sometimes—as when a Maudslays' passes—the last page of all. They record the birth of a new invention, and they tell of the successive improvements it undergoes, but of the little, familiar, everyday affairs and episodes of its life they say nothing, and they pass over its decay and death in silence and indifference. You must look to the advertisement pages for such memoirs. They will tell you when the invention first reached the market, and with what favour it was received, how long it held its place against competition, what changes and chances befell it in its life, and, finally, "last scene of all"—a blank: the pages that had known it know it no more; the sale has stopped, the invention is dead, or has been absorbed into that great Nirvana of inventions when, by the lapse of patents, they become the common property of the world with nothing left to identify them but their names, fallen, like departed saints, to be the common drudges of all men in their hours of need. . . . And as of mechanical things so of men. What a history of the condition of the country might be written with no more material than, week by week, the "small advertisements" in *The Engineer!* If to future ages there be nothing left but these, how much may they teach of the one-time history of our land! All the pitiful story of the Great War is written, for those who can read it, in those narrow columns, and week by week the later history is being inscribed in the same cryptograph. No man writes there his little needs but adds one more letter to the story. Here one may trace the troubles and anxiety of the ex-officer in a glutted market, and here the worries of the employer seeking men who are not to be found. Here is the sanguine inventor who needs but a little financial support to make a fortune for himself and others, here the merchant seeking agencies and the manufacturer seeking capital. It is a little stage; a convex mirror to the world of engineering in which scene after scene is enacted before those whose feet are within the magic circle.—*The Engineer*, London.

Dyckman Street Sewage Screening Results

Owing to a typographical error, a wholly superfluous "not" crept in to the article on "Operating Results of Dyckman Street Sewage Screening Plant" in *Engineering News-Record*, Jan. 22, 1920, p. 172. In the next to the last paragraph of the article the word "not" in the following reference to the test results of the Riensch-Wurl screens should not have appeared: "That it does not remove from each million gallons of sewage from 1,200 to 1,500 lb. of sludge." Both the table in the article and the wording of the phrase quoted seem to make the error an obvious one, but a correction is published to avoid any possibility of anyone being misled.

Old Rails With High Internal Strains Contained No Fissures

SIGNIFICANT studies of old rails were carried out recently to test the theory that transverse fissures in rails are produced by permanent strains set up by the distortion of the metal in service under rolling loads. As detailed by W. C. Cushing, chief engineer of maintenance, Pennsylvania Lines West of Pittsburgh, in a report (No. 84) to the rail committee of the American Railway Engineering Association, a number of old rails were taken out of the track and examined for structure, internal strains, segregation, and existence of transverse fissures.

Rails that had been in service from 10 to 45 years were examined; some of the oldest were of wrought-iron, others rolled from iron and steel pile, while those 10 to 25 years old were of bessemer steel. All of them "were carefully examined for transverse fissure defects, but none were found." Nevertheless their internal strains were very high according to 10-in. strain-gage measurements which were made on various strips ½ x ½-in. cut from different parts of the rails.

In the old wrought-iron rails, head strains corresponding to 24,000 to 27,000 lb. per sq in. in compression were found, which appeared the more serious because the material had a low elastic limit, 26,670 to 48,760 lb. per sq.in. The piled rails showed maximum head strains of 24,000 lb. per sq.in., and the elastic limit of the material ranged from 33,700 to 53,830 lb. per sq.in. Still higher internal strains, however, were found in steel rails that had been in service 20 to 25 years, several measurements of 36,000 and 33,000 lb. per sq.in. being made, as against elastic limits of 46,500 to 58,450 lb. per sq.in. These high values of permanent strain were measured at the surface of the head and on the side opposite the gauge side, in nearly every case. One abnormal result was a reading of 57,000 lb. per sq.in., tensile stress, in the flange of an 85-lb. rail that had been in service from 1898 to 1917; Mr. Cushing calls this "extraordinary and inexplicable."

Cause in Process of Manufacture

Segregation was rather high, particularly in the rails exhibiting the highest internal strains, and at the same time these rails showed low elastic-limit load in the quick-bend test (though not in tests in direct tension). Mr. Cushing concludes:

"If severity of service, especially by exceedingly heavy wheel loads, be the sole cause of the defect known as transverse fissure, these rails, after their unusually long service, and in some of the cases under the heaviest wheel loads in use, would be sure to be filled with transverse fissures. That such was proved by careful examination not to be the fact, that rails adjacent to and undergoing precisely the same conditions of service as those in which transverse fissures have been found do not have any, and that rails never put into service as well as those which have been in service have been shown by Waring and Wickhorst to contain microscopical cracks, seems to prove beyond a doubt that the cause, the real cause of transverse fissures must be sought in the process of manufacture."

The Niagara Falls Zoning Ordinance

A ZONING ordinance dividing the City of Niagara Falls, N. Y., into eight use districts and placing limits upon the height and bulk of buildings hereafter erected in the various districts and upon the areas of yards, courts and other open spaces for buildings hereafter erected was adopted by the City Council on Jan. 10 and amended a few days later. The ordinance creates four residence districts besides an apartment, a business, an industrial, and an unrestricted district. In the first and second residence districts all buildings hereafter erected shall be used exclusively for single families, except as regards professional offices and garages accessory to the residences and also as regards churches and educational institutions.

The third and fourth residence districts are restricted to dwelling purposes, but besides single-family detached houses these may include semi-detached houses, two-family houses and group houses made up of single-family units. There may also be located in the third and fourth residence districts churches, clubs, hospitals, sanitariums, semi-public institutions that are of a philanthropic nature, together with accessory offices and garages. There will also be permitted in the third and fourth residence districts farming, truck gardening, nurseries or greenhouses.

In the apartment district there may be erected dwellings, apartments, tenements, hotels, lodging or boarding houses with accessory offices and private garages.

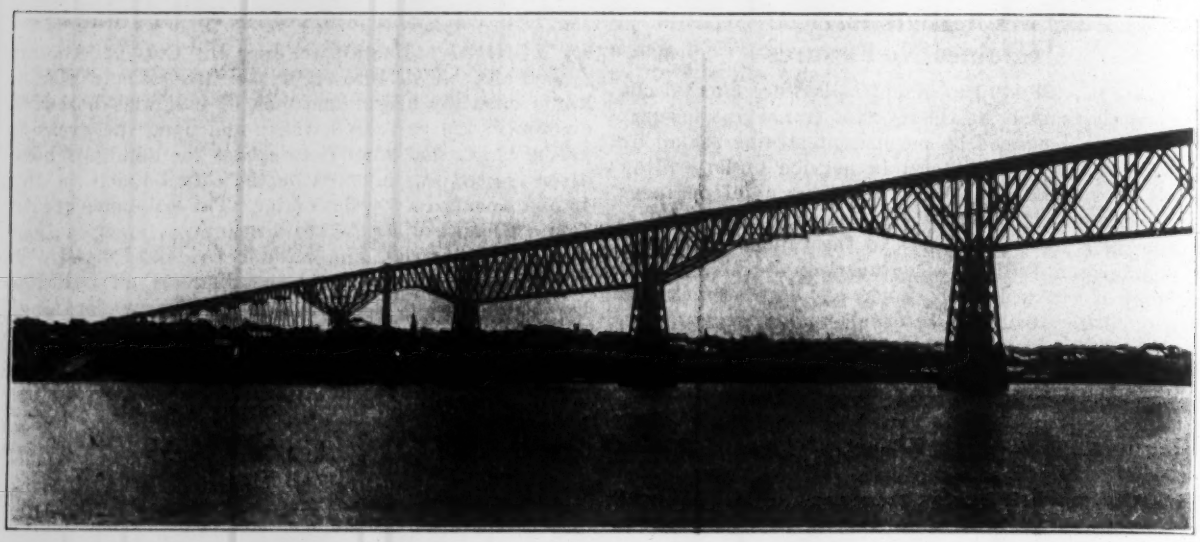
The business, industrial and unrestricted districts follow in a general way what might be expected from the terms, but there is a long list of specified trades and industries which hereafter may not be established in the industrial district but must instead be put in the unrestricted district.

The ordinance contains somewhat detailed provisions regarding the heights of buildings and the areas of lots to be built upon, but goes into more detail as regards areas than heights.

Alterations of old buildings and rebuilding operations in the case of fire are limited to 75 per cent of the assessed valuation of the building, but in the case of such alterations or reconstructions no change can be made in the use of the buildings.

The ordinance provides for the appointment by the City Council of a zoning commission of five members to serve wtihout pay for terms of four years. The duty of the commission will be to investigate all matters pertaining to the division of Niagara Falls into districts as provided for in the ordinance and in general to see that the terms of the ordinance are carried out. Provision is made for amending or repealing provisions of the zoning ordinance, but all propositions of the kind must go to the zoning commission, be reported upon by it and also be acted upon by the City Council within thirty days in each case, and no amendment to the zoning ordinance shall be adopted by the Council contrary to the recommendation of the zoning commission except by unanimous vote of the Council.

Violations of the zoning ordinance are made misdemeanors, subject to fine or imprisonment, or both, and either the City of Niagara Falls or any resident property owner may maintain an action to restrain by injunction the violation of any of the provisions of the ordinance. E. J. Fort is city manager of Niagara Falls.



Reconstructing Poughkeepsie Cantilever Bridge for Heavy Traffic

Second Revision of Notable Structure in Thirty-five Years — Double-Track Deck Over Three Trusses Changed to Gauntlet-Track Deck — Putting Stress Into Reinforcing Material — Strain-Gage Work

BY CLEMENT E. CHASE
Resident Engineer for Ralph Modjeski, New York City

THE Poughkeepsie Bridge, one of the most widely known structures in the country, by reason of its height and conspicuous location above the Hudson River, has recently undergone its second extensive reconstruction to keep pace with the growth of engine and train loadings since its completion in 1882. Designed for a train load of 3,000 lb. per ft. on each of two tracks, with engine axle weights of 24,000 lb. each, it was first strengthened in 1907 to accommodate a double-track loading of 3,600 and 45,000 lb. and then in 1918 remodeled to permit the use of a single-track loading of 6,000 lb. with 60,000-lb. concentrations (the two tracks being gauntleted). In Fig. 1 is shown the new loading diagram, 2-10-2 engines double-headed.

The familiar outlines of its trusses have remained unchanged, although nearly as much metal has been added as there was in the original structure.

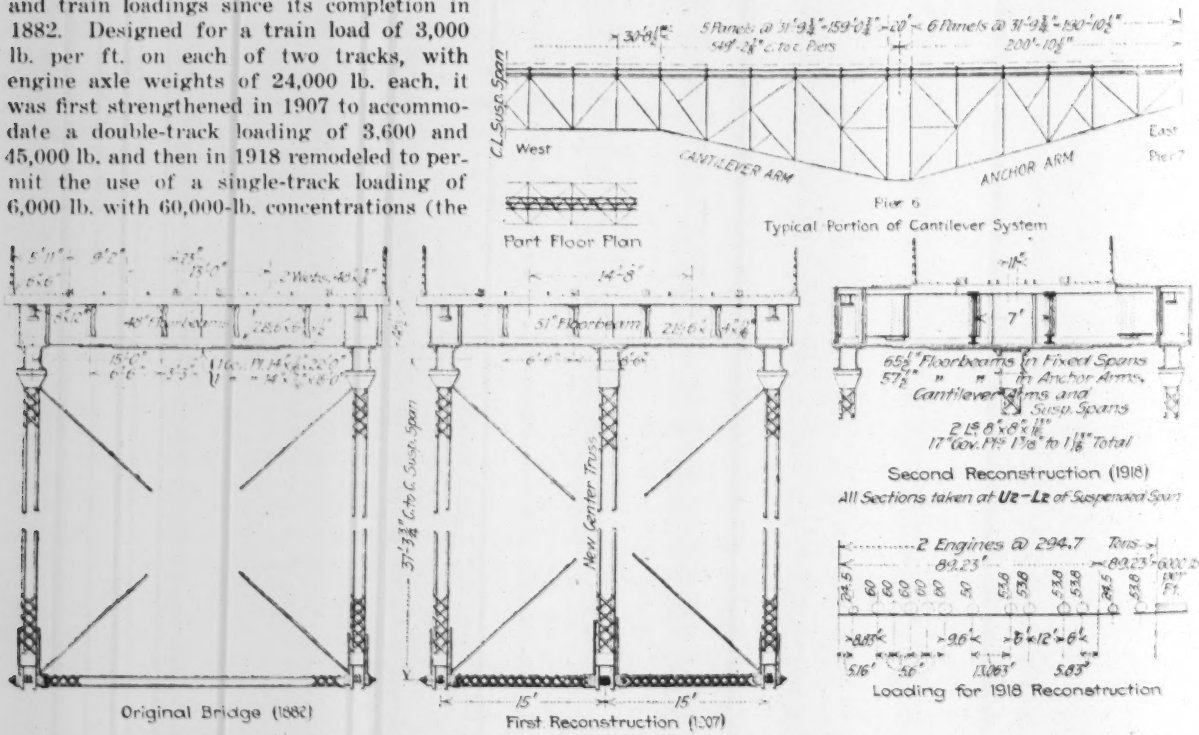


FIG. 1. POUGHKEEPSIE BRIDGE. THREE DIFFERENT TYPES OF CONSTRUCTION USED AS LOADS INCREASED

The bridge has the distinction of being the only one across the Hudson River south of Albany, and the Central New England R.R., subsidiary of the New York, New Haven & Hartford R.R., which operates over it, is the most direct route from both the bituminous and the anthracite coal fields to the New England manufacturing centers. With its approach viaducts, the structure is 6,767 ft. 3 in. long over all. The main spans over the Hudson constitute a deck cantilever system with two fixed spans 525 ft. long, three cantilever spans 546 and 548 ft. long, and two anchor arms 200 ft. 10½ in. long.

The first reconstruction was necessary after twenty years, and at this time a central truss was added to the original two trusses (middle sketch in Fig. 1) throughout the river portion, the added truss being similar in profile and web dimensions to the old ones but 50 per cent heavier. This third truss was practically an independent bridge, being supported by its own steel towers resting on steel cylinder piles driven through the old pier core to foundation. The erection of this steelwork, a very difficult and dangerous undertaking, was completed in 1907. Ten years later, in January, 1917, a contract was signed for the second remodeling, which nearly doubled the weight of train and engine that could be safely carried, by utilizing all three trusses of the main spans to carry a single-track load. The traffic density on this line is not yet great enough to make this short stretch of single track a factor in limiting movements, and on the other hand the powerful Santa Fé engines which the bridge can now carry give notable operating advantages.

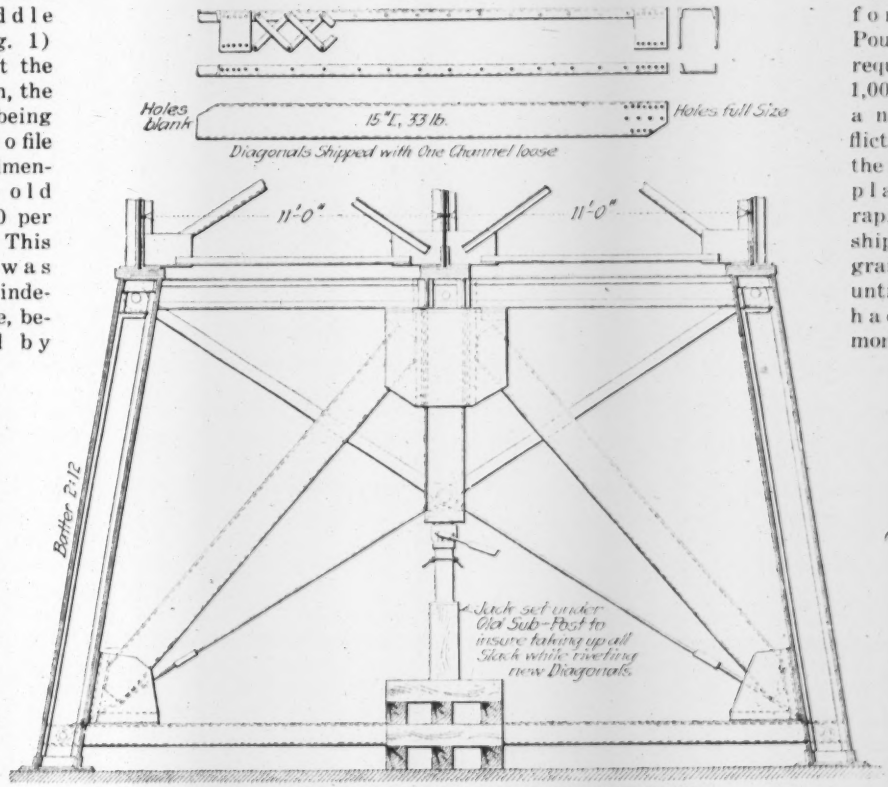

Holes Blank
15"I, 33 lb.
Holes full Size
Diagonals Shipped with One Channel loose
11'-0"
11'-0"
Batter 2:12
Jack set under Old Sub-Post to insure taking up all Slack while riveting new Diagonals.

FIG. 2. NEW DIAGONAL POSTS IN APPROACH

This solution of the problem of making the structure equal to its proposed new burdens was arrived at after thorough study by the consulting engineer of three alternative possibilities: (1) Distributing single-track loading over the three trusses, as finally decided upon, (2) reinforcing the trusses for double-track heavy loading, and (3) rebuilding the bridge. The most economical and effective method of securing the distribution of the single-track load over all three trusses was next investigated. A stiff floor beam, as a means of equalizing truss deflections, was preferred to the alternative of an articulated system of load distribution. Consideration was given to splicing and reinforcing the existing floor beams, to a combination of new floor beams and reinforced old stringers, and finally to the adopted course of renewing the entire floor, designing it for use in the proposed future two-truss two-track bridge but placing only two lines of stringers for the present. For the approaches, reinforcing and singletracking were each resorted to, in different sections.

Mill orders for material were placed in February and March, 1917, for delivery in time to complete shop work by early summer. War came, and all peace-time mill schedules were forgotten. The Poughkeepsie work required nearly 1,000 tons of plates, a need which conflicted directly with the demand for plates for the rapidly growing shipbuilding program. It was not until the rollings had dragged for months and it was appreciated that the delay would have a serious effect on New England traffic that the necessary priorities were granted. Fabrication of 1,600 tons of metalwork was completed in two months after steel was delivered at the shop, and erection was pushed at Poughkeepsie during the bitter winter of 1917-18. The first of the new engines passed over the bridge May 16. 1918, but as every feature of the work not directly connected with getting one track safe throughout the length of the bridge had been set aside to that end, the contract was not completed until Aug. 3, 1918.

On both approaches double-track was retained for the most part, and therefore the work to be done was of less unusual kind with respect to the handling of traffic than on the main bridge. It was also first in point of time. Work began at the east end of the east approach in July, 1917.

The scheme of reinforcement applied to the viaduct bents of about one-third of the east approach and 600 ft. of the west is indicated in the sketch Fig. 2. The main viaduct girders had replaced the original lattice trusses in 1907 and were adequate, with slight changes, for the proposed loading. In the bent itself, however,

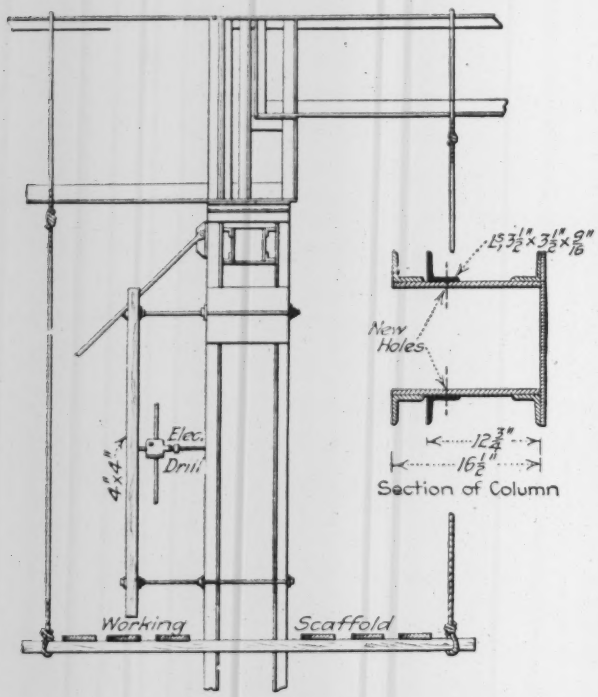


FIG. 3. ANGLE REINFORCEMENT, OUTER COLUMNS, IN PART OF APPROACH

both the king-post truss and the columns would be overloaded, so that the stiff diagonals shown were added to relieve both, by taking the center-girder reactions which the truss had formerly carried to the columns. The diagonals were shipped in two parts, so that they could be erected around the existing bracing, and before their connections were riveted slack was introduced into the old truss by jacking up the center post, as shown.

In the westerly two-thirds of the east approach a center line of columns had been added in 1907, and here the only deficiency in strength was in the outside columns, which, therefore, were reinforced by the addition of two angles riveted to the webs of the outside columns, offset toward the open side of the section so as to improve its balance (Fig. 3). The placing of this reinforcement was a tedious operation, as swinging scaffolds had to be lowered the full height of the towers, step by step, for drilling the holes in the column webs and again for riveting.

In the portions of the east and west approaches containing truss spans, more elaborate methods of strengthening had to be applied, as shown in Figs. 4 and 5. To have retained the existing track spacing of 14 ft. 8 in. on the two 145-ft. deck truss spans of the west approach would have necessitated strengthening all three trusses. By moving the tracks closer together, to 13 ft. centers, the load on the outside trusses was reduced so that they were adequate after the U_3-L_4 diagonals were stiffened, and all other work was confined to the center truss. This was very extensively reinforced (Fig. 5) with side plates on the top chord and stiff diagonals, loop rods on the tension members U_1L_2 and a complete riveted tension system built around the bottom chord. At the towers the center girder was removed and replaced with a new girder, the girder seats between the column webs were strengthened, and side plates were added to the center columns throughout their full height. In only one stage of this west-approach work was it necessary to interfere with the unrestricted operation of trains. This was in placing the new center tower girders (see the views Figs. 7 and 8). Temporary crossovers were placed so that all traffic could be diverted to the north side of the bridge, and the south track and timber deck was removed over the towers. Lateral and sway-brace rivets were removed and replaced by bolts. Following the passage of an important train, rails were cut on this remaining track and the entire 30-ft. section of decking picked up by locomotive crane and shifted bodily 18 in. north. The old center girder was then removed, the new one placed, decking set back and rails connected. The track was broken 1 to 1½ hours.

The design contemplated forcing initial stress into the new tension material of the approach trusses, Fig. 5, so that the dead-load stresses in old and new steel should be equal. For this purpose the following method was prescribed:

The gusset plates at field splices had full-size holes, while one end of each member connecting to them was blank. After pulling the new steel firmly into contact against the old pins, and with the drilled end well driftpinned and bolted, the holes in the blank end were to be laid off through the holes in the connecting plates. These centers were then to be offset so as to shorten the distance between the end connections of the members by an amount slightly greater than the elongation desired. After these holes were drilled the connecting plates were to be drawn up into contact, by undersize bolts, and several driftpins then entered in the slightly offset holes and driven home by blows in succession on one pin after another (to avoid stretching the holes by putting too great a strain on any one).

This method was followed in adjusting the loop rods U_1L_2. The actual elongation of the reinforcement was measured by an extensometer, Fig. 6, devised in the field and constructed in a local motorcycle repair shop. The instrument measured the stretch in a gage length of 57 in., multiplied 8.77 times by the lever arm of the movable-gage point and read between the jaws of an ordinary micrometer caliper, so that the reading of the micrometer divided by 500 gave the deformation

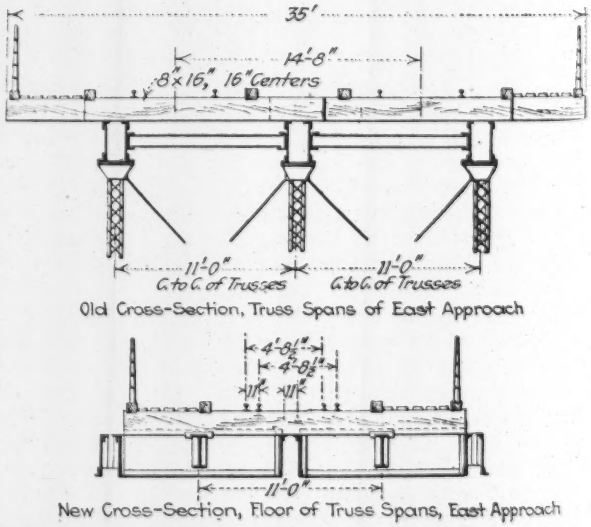


FIG. 4. NEW FLOOR SYSTEM OF EAST APPROACH TRUSSES

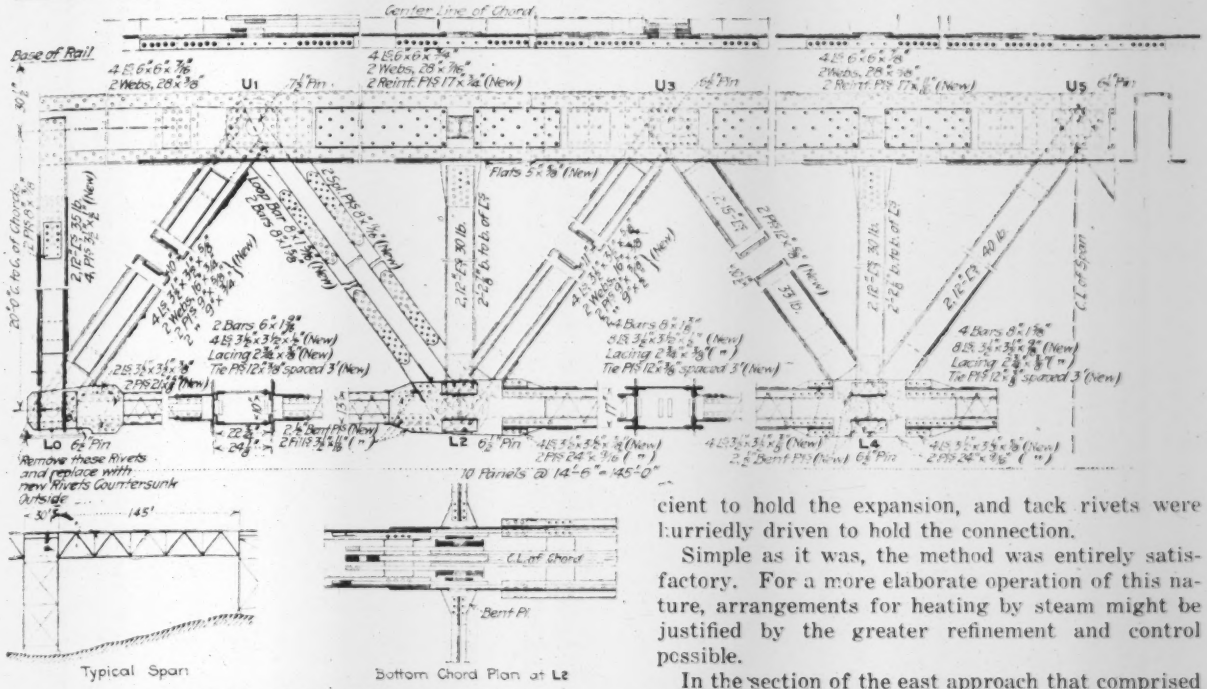


FIG. 5. STRENGTHENING CENTER TRUSS OF WEST APPROACH SPANS

in an inch. With this instrument clamped to the member and the gage points set in small drilled holes, very satisfactory readings of the gradually applied stress could be obtained. The instrument was too flexible to give accurate results if removed and replaced between readings. Further, if a considerable length of time were required to introduce the stress into the member, temperature variation would be confusing, as the instrument would not expand with the member.

For the bottom-chord reinforcement this same method of introducing initial stress could not be successfully carried out, as one end of each panel-length of reinforcement had been riveted to the connecting gusset. After the latter had been erected over the bottom-chord pin, the member could not be shifted to drill holes properly offset. The expedient of stretching the reinforcement by heating was then resorted to.

Adjustment was started at the center panel of the bottom chord, as the load was here a maximum and the bearing of pin holes against pins would not be subsequently disturbed by the work in adjacent panels. The dead-load stress in the 29-ft. panel was to be uniformly distributed over 52 sq.in. of old section and 22.2 sq.in. of reinforcement, corresponding to a resultant elongation of about 0.04 in. The same elongation would be caused by a uniform rise of temperature of 17° F.; therefore, if heat were applied uniformly over most of the length of the member, the required expansion would be obtained long before there could be any danger of damage to the steel.

In applying this principle the connection was lightly bolted up and two sharp chisel marks about $\frac{1}{16}$ in. apart were made across the edges of the reinforcing angle and the plate to which it connected. Small fires fed by chips from the creosoted deck timber were then built along practically the entire length of the reinforcement. As soon as the angles lengthened the desired amount, the fires were reduced to an amount just sufficient to hold the expansion, and tack rivets were hurriedly driven to hold the connection.

Simple as it was, the method was entirely satisfactory. For a more elaborate operation of this nature, arrangements for heating by steam might be justified by the greater refinement and control possible.

In the section of the east approach that comprised similar deck truss spans to those of the west approach a different solution was used. Instead of retaining the double track and making extensive truss reinforcements, it was possible to continue the gauntlet track of the main spans east over the 800 ft. of truss-span viaduct. The loads were distributed to the three trusses in proper proportion by a steel floor system, Fig. 4, framed in between the top chords. The old timber deck had rested on the top chords of the trusses.

In the new main-span floor system the floor beams were designed to carry double-track loading when spanning the 30-ft. width of a proposed future two-truss bridge. Only the inside stringers of the two future pairs are placed for use with the gauntlet-track arrangement, but connections have been provided in the floor-beam webs for future outside stringers.

Levels taken across the old structure at all floor-beam bearings, preliminary to design, had shown the top-chord profile to be very irregular, following in a reduced scale the rise and fall of the bottom chord. Transversely, also, the bearing points had different levels for each truss, at each panel point. To make up these differences in level and give bearing on all three trusses, five different depths of floor beam were used, and various fillers or bolsters provided. With the profile of the new floor-beam bearing surfaces corresponding to the difference in level of the three bearings

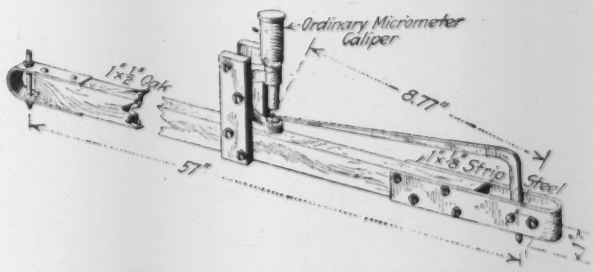


FIG. 6. EXTENSOMETER USED IN STRESSING REINFORCEMENT

in the old trusses, the relative elevation of the trusses at each panel point would not be changed by the placing of the new floor system. This meant that the distribution of stresses from dead load would remain the same.

Used thus with the three-truss structure, the heavy floor beams act as rigid cross-girders which compel the three trusses to deflect equally under live load, save for the influence of the slight deformation of the cross-girders themselves. In their present use the floor beams are stressed up to only about one-third their working strength and their deflections are correspondingly small, in general less than $\frac{1}{16}$ in. Because of the relatively great deflections of the structure itself, the difference, then, between calculations of stress in the trusses with beams assumed inelastic and with the beams assumed elastic was very small. The latter case resulted in an average decrease of stress in the outside trusses of 1.3 per cent and a corresponding increase in stress in the center truss. The only case where a materially greater difference than this occurred was in the vertical posts over the pier towers, where it amounted to from 12 to 16 per cent, but with a maximum stress much below their allowable working strength.

Looking at the case broadly, the existing bridge had been found adequate (under usual design specifications) for E35 loading on both tracks or for E70 on a central track if this latter loading could be ideally distributed. As it was being remodeled to carry approximately E60 loading, each truss would only get six-sevenths of its capacity stress if proportionately loaded. The difference between six-sevenths and unity represented a margin ample to cover the effects of girder deflection and imperfect bearings for the trusses as a whole.

In December, 1917, the situation was that, although there was still work to be done in strengthening the east and west approaches, there would be no difficulty in completing this work by any date at which it would be possible to have the main-span floor system changed. The latter therefore became the controlling factor in getting the bridge ready for the passage of the heavy power and the erection was planned accordingly.

The method of change from old to new floor system had to provide, first, for no interruption to traffic except during working periods of not more than three hours; second, for a shift from double track to gauntlet track; and third, for an 8-in. change of track-level —all in addition to the requirements of safety, speed and economy.

It was evident that if the traffic could be shifted to its final position, on center-line track, entirely across the bridge in advance of the operation of changing the steel, a considerable economy of time would result. Investigation developed that the 8 x 10 in. ties provided for the new deck would, when spaced 16 in. on centers, safely carry the maximum axle concentrations in use on the line at the time, when spanning 8 ft. 6 in. between the inside stringers of the old floor system. Accordingly, one of the existing tracks was removed, half the old deck stripped, the new ties laid in approximate center-track position (which could be done without disturbing traffic on the remaining track), and the central track laid.

Erection was begun at the east end of the main

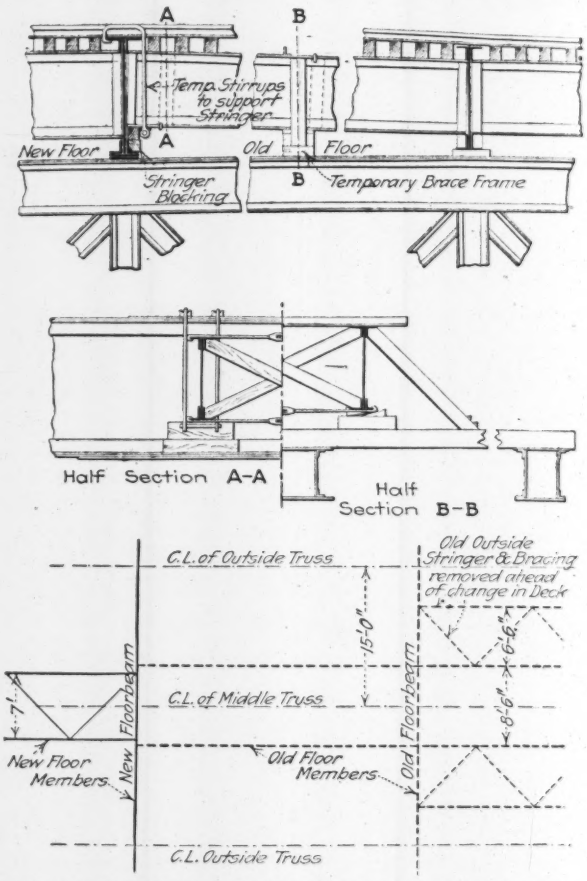


FIG. 9. ERECTION OF NEW FLOOR OF MAIN SPANS; CONNECTION TO OLD FLOOR

FIGS. 7 AND 8. SETTING NEW CENTER GIRDERS OF TOWERS OF WEST APPROACH AFTER SHIFTING TRACK

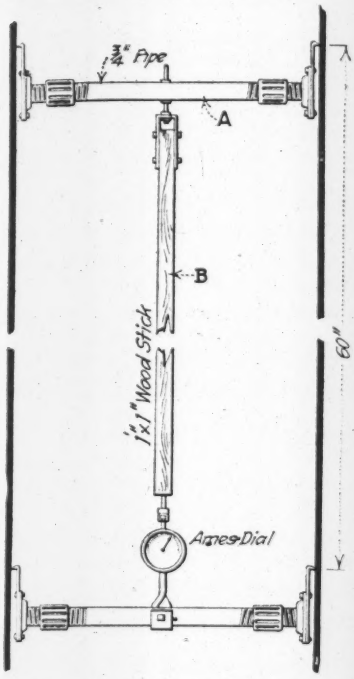


FIG. 10. EXTENSOMETER FOR CHECKING LIVE-LOAD DISTRIBUTION

spans, and the end floor beam was changed first, as an operation by itself. Thereafter the changes were all in full panels — two stringers and one floor beam—or multiples thereof, so that the connection between old and new steel always came at a new floor beam. The method of carrying traffic over the junction is shown in Fig. 9. The new stringers are 7 ft. apart, while the two inside lines of stringers of the old floor were spaced 8 ft. 6 in. Half of the holes in the connection of the new stringers to the new floor beam were obstructed by the end angles of the old stringers, but sufficient bolts and pins could be placed in the open holes to take care of the end shear of the new stringers safely under the limited loads. To support the near ends of the old stringers a yoke or double hanger device made in the field was used, supplemented by blocking to the floor-beam flange below. In addition, it was possible to place one or two bolts or pins in holes in the old connection angles that happened to coincide with holes in the new stringer connections, to give lateral stability. The bottom flange of the floor beam was very heavy and the blocking between it and the bottom flange of the stringers was effective in carrying a large part of the end reaction. The center of the old stringer span was stayed laterally by the temporarily cross-frame and inclined timber struts shown in the sketch. This was necessary after the removal of the outside stringers, as the stringer laterals were between the outer pairs.

Actual floor replacement was done in working periods which were usually limited to three hours. The first panel was changed out in 3 hr. 42 min., the second (the following day) in 2 hr. 52 min., the third in 2 hr. 31 min., the fourth in 1 hr. 51 min. As soon as the work had been systematized and the men become familiar with their duties at each step, it was undertaken to change two panels in the working period. This was first done in 2 hr. 55 min. As it took a certain time, practically independent of the number of panels placed, to break track and later connect the old and new steel and close track, it was very desirable to complete as many panels as possible in one three-hour period. The number of panels was raised to three, but it was not found possible to maintain this speed all the way across the river, because of shortage of ironworkers. There was much preliminary work necessary before the working periods, which could not be kept up to the pace that could be maintained by the erection gang alone. The best record made was the removal and replacing of three panels in 2 hr. 45 min. from the time track was broken until it was connected.

The work of changing this main-span deck was carried out during the very severe weather of the winter of 1917-18, and the men were exposed to the full sweep of wind along the Hudson River valley. Handling the girders and stringers, with their large area catching these winds, was at times difficult and dangerous. As a safety precaution the sidewalk planking from the old deck was laid across the top chords as a working platform. The entire contract was carried through without a fatality or a serious injury.

At the time the floor beams were first erected, no effort was made to bring them to bearing on the three supports. The unsymmetrical loading from the partially stripped old deck made the relative deflections of the three trusses entirely different from what they would be later, with the new floor entirely in place. For the time being, the newly erected cross-girders bore at random on two of the three supports, which was sufficient for engine service during erection. Later, as the trusses came more nearly to their final elevations under the load of the complete new floor system, the additional shims that had been provided for the purpose were placed as required, to bring each floor beam to bearing on the three trusses. After the shims were in place, the holes for bolts connecting the floor beams to the trusses were drilled.

After erection was completed and the remodeled structure was carrying the heavy engines, a few check stress measurements were made for comparison of actual with theoretical distribution of loads to the three trusses. A vertical member over one of the piers, one near the center of the suspended span, and a top-chord member of the suspended span, were drilled on the neutral axis of each web for readings with an 8-in. Berry strain-gage. Measurements of these gage lines under dead load only were made before and after each set of live-load readings. These determined the rate of change of length due to temperature variation. A corresponding correction was made to the indicated changes of length under the engine load. The measurements were made under static live load, with the engine spotted to give maximum stress in the member.

The readings with the Berry gage were later checked by another series made with an apparatus constructed by the writer. This device, shown in Fig. 10, registered the deformation of a 60-in. length of the member on an

FIG. 11. GASOLINE-DRIVEN DAPPING MACHINE FOR FLOOR TIMBERS

Ames dial. The crosspieces *A* were of ¾-in. pipe. By means of the right-and-left-threaded couplings the spring grips were forced against the webs to give secure knife-edge contact. The wooden rods *B* were adjustable by the bolt at the top to any desired initial reading of the Ames dials. The dials were clamped in place after the remainder of the apparatus was in position, and were removed whenever the observer left the bridge. The device was particularly well adapted to the rapid determination of the load taken by the whole member (which was the point of interest in this investigation) as the instrument itself averaged the deformation of the elements which would be measured separately by other types of gage. In actual operation it was not necessary to stop an engine longer than five minutes to get a checked set of readings by one observer.

The results obtained with the 60-in. gage checked quite closely those previously obtained with the Berry gage. Both sets showed that the assumptions as to load distribution made in the design were borne out by the action of the remodeled structure. Two of the three sets of members tested showed interesting individual variations from the ideal distribution, but the resulting total stresses were well within safe limits.

At the tower vertical, the outside posts showed greater live-load stress than the center post, whereas theoretically, with the slight deflection of the cross-girder, the opposite would be expected. Examination of the bearing of the cross-girder on the three posts disclosed the reason. At the center bearing, owing to the warping of the filler plates in shearing, there was a certain amount of play, less than $\frac{1}{16}$-in.; this had to be squeezed out before the center post commenced to take its live load. The difference in actual stress was small, and was amply within the allowance that had been made to cover the difference between ideal and actual conditions of fabricated steelwork and erection. The posts were 75 ft. long down to the tops of the massive A-frames of the towers; a stress of 900 lb. per sq.in. on the two outside posts was enough to compress them sufficiently, together with the deflection of the girder, to bring the center bearing firmly into contact. For the succeeding increments of live load the center post took its full share.

The top chords of the suspended span, which were considered as representative of the principal truss members, showed approximately equal increments of stress under the maximum engine load. The post U_2L_2, which took only direct engine load, showed a greater stress in the center truss than in the outside trusses, the difference being equivalent to that caused by a floor-beam deflection of $\frac{1}{32}$ in. The deflection directly under the engine would be taken up partly by compression of this one member, rather than by the deflection of the truss as a whole, as any tendency for the center truss to deflect more than the others would be resisted by the rigid floor beams at adjacent panel points.

Edward Gagel is chief engineer of the Central New England R.R., which owns and operates over the bridge. The design and supervision of the work of reconstruction was in the hands of Ralph Modjeski, consulting engineer. The writer was resident engineer for Mr. Modjeski, and Charles Kahn was assistant resident engineer. The steel was fabricated for the Strobel Steel Construction Co. by the Fort Pitt Bridge Works. The former company handled the erection with its own forces, under William McAley as superintendent.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

The Problem of Handling the "External Relations" of Engineering Societies

Sir—On p. 488 of your issue of March 4, 1920, there appears a communication signed Gardner S. Williams, whose title as signed thereto, as well as the fact that he has served for five years on the Board of Direction of the American Society of Civil Engineers, may lead those interested to believe that he knows what he is writing about.

Mr. Williams has indicated that in some way the undersigned is responsible for the report of "the committee on budget;" and I desire to say that this is not in any sense correct.

I wish also to point out to Mr. Williams that, in the interest of accuracy of statement, a "late secretary" should not be referred to, especially in the same sentence, as "retiring."

I feel impelled also, no matter how much anyone's feelings may be hurt, to state without fear of contradiction, or of possible "misinterpretation," that, although my health is not good I am still alive, and that I can still write after my name "Secretary, American Society of Civil Engineers."

New York. CHAS. WARREN HUNT.

Sir—The letter of C. E. Drayer in your issue of Feb. 12, under the caption of "How Shall the Co-operation of All Engineers Be Effected" and offering a solution to this momentous question, seems to my mind to raise another question: "Why should engineers who belong to already well established national engineering societies let the settlement of co-operation rest with the comparatively new-born society, the American Association of Engineers?"

With all due respect and appreciation of the purpose and ideas of the American Association of Engineers and with no derogatory intention on my part, I am not in favor of resigning the settlement of this question to that association. The situation here seems to me to be somewhat like the case of a young engineer just out of college who is full of theory about pile-driving and tries to tell the foreman of the pile-driving team, who has spent all his life in this work, how best to drive piles.

The founder societies, which are all of early origin and stand foremost in the advancement of the engineering professions, composed of men with long experience and sound judgment, are, in my opinion, the means to this end. Even if the American Association of Engineers has for its purpose activity in social, economic problems, etc., why should this association be more capable of carrying out the non-technical activities recommended in the Joint Conference Committee's report than a combined effort of the founder societies? It is my opinion that this was in the minds of the Joint Conference Committee and the reason why reference was not made to the American Association of Engineers.

I do not wish to convey the idea that I am in favor entirely of the plans as outlined by the committee. In their zeal to make co-operation between the societies a

reality they have overshot the mark in certain respects, for instance, the formation of an entirely new "national engineering organization" as outlined in their report. If such a plan were carried out, the individuality and effective influence upon society that each society now possesses, to my mind, would be entirely swallowed up. This creation would set each society adrift from its traditions, high ideals and standards. It would stifle the individual efforts of each society to promote the engineering profession in its particular branch. In other words, the effective influence upon Society would be forever lost. This plan should never be accepted and to my mind should be voted against by all societies.

Why could not a national committee with one representative from each society, irrespective of size and membership, be formed to act only upon co-operative matters and to express, when necessary, a unified opinion upon national questions?

CARL W. WOOD
Assoc. M. Am. Soc. C. E., Am. Int. Shipbuilding Corp.
Hog Island, Pa.

Sir—The rank and file of the engineering profession may rejoice with good reason on learning that the governing boards of the founder societies and the American Society for Testing Materials at their joint conference of Jan. 23 adopted in principle the Development Committee's report. Yet, for many, the pleasure this news will create is largely in the realization that many of the more conservative members of the profession have seen the light beyond. They have recognized that there is need for attention to matters of general moment to the profession which have been generally regarded as being outside the sphere of primary activities of technical engineering societies. But further, these conservative ones see the necessity for a great national organization whose activities shall be toward the solution of those problems, non-technical in character, in which all engineers have a common interest—an organization which may speak for the great mass of the profession.

The form of organization proposed in the development report is virtually a federation of existing local, state and national societies. The history of federations in general is a record of inefficiency; of groups seeking to gain advantage over groups; of distrust, discord, and comprise. The jealousies of the individual groups sooner or later lead to practices which either render useless the federation or cause its complete collapse. Of course it is possible in the present instance that the usual difficulties will not be encountered, yet on the whole there is no reason why history should not repeat itself. For this reason not a few of the thinking men of the profession, members of the founder societies as well as non-members, regard the formation of an organization along the lines proposed as a questionable, if not a dangerous, experiment—an experiment which will neither lead to the solidarity of the profession nor to an increase in the present usefulness of any of the professional societies of which it would be composed. As one holding membership in one of the founder societies I may say that I feel that it would be a mistake for my society—which has served so well the technical needs of its special branch of engineering, has done so much to advance our knowledge of the forces of nature and of the use and behavior of materials, and has in other ways sought to make and made engineering a learned profession—to "adopt the principle of becoming an active national force in economic, industrial and civic affairs" or to actively co-operate in the creation of the federation proposed in the development report.

Rather I feel that these societies should restrict their primary activities to such matters as have held their attention in the past and that *as societies* they should co-operate in the furthering of this movement for an all-inclusive welfare organization of engineers only to the extent of endorsing the general form and activities of such an association, leaving the financial support to their individual members.

In consideration of the clear recognition by the great mass of the profession that there is need of a truly representative, all-inclusive engineering association to look after our non-technical interests, and of the fact of its being most evident that there are advantages in such an association's being composed of individuals rather than of groups, and truly democratic in character, inviting the confidence of the rank and file of the profession, it seems to me both logical and fair to inquire as to whether there be not in existence some living society whose avowed objects and activities are harmonic with those proposed in the development report.

I believe in giving credit where credit is due, and I believe in using existing machinery rather than trust to untried devices when such is possible. However, much any of us may belittle the early history of the American Association of Engineers, we can not but admit that it has been a vital factor in awakening the older national societies to the need for action along the lines it is pursuing. Also, during the past year, it has established records, not only in increases in membership and in attracting the thinking men of the profession to its ranks, but in welfare activities which stand preëminent in the history of society achievements. Its form of organization seems to be almost ideal, and it is democratic to the core. And a few would venture to say that it does not command the confidence of the rank and file of the profession.

I can see no logical reason why this association should not form the nucleus of a larger, more truly representative, more powerful, more efficient and more enduring welfare organization than that proposed in the development report. I believe that a joint conference of the governing boards of this association and the founder societies might be productive of an exchange of ideas which would, at no distant date, bring about the founder societies' endorsing the objects and methods of the American Association of Engineers, the founder societies being relieved of all direct support in the movement except for the maintenance of advisory committees. It is conceivable that, by such procedure and the active support of individuals of the older societies, the growth of the American Association of Engineers would be nothing short of marvelous and that within a very short time we should have the thing sought without duplication of effort and without interfering with the primary activities of the older national societies. And I can not see how such procedure can either weaken the prestige of the founder societies or fail to affect a closer unity in the profession.

RAYMOND E. DAVIS,
Associate Professor of Civil Engineering, University of Nebraska.

Shall the Am. Soc. C. E. Enter the Field of Civic and Economic Affairs?

Sir—Shall the American Society of Civil Engineers adopt the principle of becoming an active national force in economic, industrial and civic affairs? In reply, the first impulse is emphatically, *yes*; second thought brings the query—why not? Because it never has, is no reason why the society should not make a radical departure. It has made a success in purely technical, non-human lines—in the problems of economic combination and use of wood, stone, steel and cement, of water and of fire. Why not now venture, with hopes of equal success, in the wide fields of human affairs, and do its part as a national force in the problems of economics, such as railroad operation and maintenance, and the pay of railroad engineers and mechanics; in industrial affairs, to promote higher efficiency, better management, improved relations with labor; and particularly in civic affairs, going into the duties of the members in their relations to national policies and politics?

"Politics makes strange bed-fellows," and the mention of civic affairs at once brings up the question as to who are to be our associates in this venture. If the field were open, and we had the undoubted leadership, there would be little cause for hesitation; but the American Society of Civil Engineers is not the only, nor is it the largest, body in this field of human affairs. While influential in purely technical relations, relatively it must be quite insignificant as a national force in economic, industrial and civic affairs. To be of influence it must unite with others and be content "to play second fiddle." It must also divert from technical study and publication considerable sums of money, as well as the energy of its officers; or rather, for success, it must put the control of affairs in the hands of men selected, not because of their pre-eminent ability as technicians, but rather as able economists and politicians. Can this be done without sacrifice?

Five years ago, the American Society of Civil Engineers had the lead, but declined or neglected to cooperate with lesser organizations. Thus because of lack of sympathy and support, many of the younger engineers, men who should have been attracted and held, formed an association of their own, incorporated and designed to be an active national force in economic, industrial and civic affairs. After slow growth and many disappointments, this organization, the American Association of Engineers, has spread; it has aroused the enthusiasm of active men, and now, as a great ground swell, is sweeping onward, bringing in local and state engineering societies, and going into the highways and byways for membership, as well as into the crowded centers. It now has the lead, in numbers, in energy, in youth, and in enthusiasm.

In going into any field of endeavor, in economic, industrial or civic affairs, the older, slower-moving American Society of Civil Engineers must be prepared as a minority to follow the younger but larger, more democratic, association. As opposed to this view, some persons have brought forward the probability that the civil engineers could combine with the three other older technical or specialized societies, covering the related branches of mechanical, electrical and mining engineering, and by such combination maintain a control. In this event, however, the American Society of Civil Engineers must still play a minor part; its associates may at any time form new combinations, in which it must pay its share of the expenses.

In short, the question resolves itself into the query: Should the American Society of Civil Engineers, with relatively small membership and with experience and traditions averse to dabbling in economic, industrial and civic affairs, try to enter the field of a larger, more active group, one which is spending practically all its money and energies on these lines? If the answer is *yes*, then will the American Society of Civil Engineers be content to pay its share and follow the lead of the larger group?

F. H. NEWELL,
Member Am. Soc. C. E. and A. A. E.

Gossip Regarding the New York Section of the Am. Soc. C. E.

Sir—In behalf of the recently formed New York Section of the American Society of Civil Engineers, the undersigned officers of the Section desire to make the following statement in regard to its purpose and organization. Such a statement seems to be called for by your news item of March 4, very appropriately headed "Gossip Regarding the New York Section, Am. Soc. C. E.", but representing as facts certain things not really such. If, however, the article helps to bring into the Section those who have not hitherto joined, and particularly if it brings in more of the younger element, whether or not they favor the program of the Development Committee, and thus aids in making the Section a large and representative one, a useful purpose—one of the main ones for which the Section was formed—will have been served. To this extent we are grateful for the opportunity for a reply and hasten to grasp it.

In order to form the Section it was necessary, under the rules of the Society, for a certain number of members to request from its governing board authority to form it. It was not so easy as might be expected to secure the necessary number of signers to the request. Some of our most ultra-conservative members are opposed to local sections in any form. Others were doubtful as to the material return. Finally, twenty-seven adventurous spirits in the local membership—but varied in respect to age—signed the request, which was granted, paid in their money, and the Section thereupon became an accomplished fact. After having participated in so radical a proceeding as that above described, the officers and other pioneer members of the Section may well feel disturbed and puzzled at being classed as ultra conservative. However, the present officers are to serve only until the annual meeting May 12, which meeting marks the beginning of a new term.

There is no truth in the statement that at the organization meeting of the Section the proposal was made that the Section should combat the recommendations of the Committee on Development.

The constitution of the Section provides that any member of the Society may join the Section merely by registering with the Secretary of the Section and paying the current dues of $5. There is no bar to admission on account of age, color, creed, or previous condition of servitude. Moreover, there is no initiation fee. It is hoped that many will join before the next meeting.

The next meeting of the Section is set down for 8.30 P.M., Wednesday, March 31, at the Engineering Societies Building, 29 West 39th St. All members resident in District No. 1 of the Society are to be invited to qualify for membership so that they may attend as mem-

bers of the Section. The subject of discussion has not been announced but will be appropriate to the occasion.

The New York Section of the American Society of Civil Engineers has a promising field of usefulness before it. It is a wonder that it was not formed before. It should serve as the organized means of expression for the resident membership on all matters of common interest, to the benefit of the Society as a whole. Its formation and purpose have no necessary relation to the program proposed by the Committee on Development, but if that program is put into effect the Section will become the agency through which all local activities will be conducted, and will be on the ground, ready to carry on.

ROBT. RIDGEWAY,
President.
LOUIS D. RIGHTS,
Secretary, New York Section, Am. Soc. C. E.
New York City.

Internal Affairs in the Questionnaire of the Am. Soc. C. E.

Sir—Although the writer has very decided convictions that affirmative answers to the questions on internal affairs, submitted to the members of the American Society of Civil Engineers are the only ones that a broad-minded well wisher of the society can conscientiously make, it nevertheless seems to him much more important that the questions be intelligently answered than that they be answered either "Yes" or "No."

In the hope of rendering a service to those who feel in doubt as to the meaning of the questions asked, the following explanations are submitted:

Question B-1. Shall the recommendations of the Committee on Development as to technical activities be adopted? (Report, Division A, Sections 1-5, pp. 4-6.)

The recommendations referred to are essentially:

1. That local associations hold at least four meetings annually:

2. That the fortnightly New York meetings be abandoned;

3. That semi-annual meetings, in spring and fall, be added to the present general meetings of the society, and that technical matters be made a part of the program of these meetings and of the annual convention;

4. That papers be solicited along special lines, in accord with a prearranged program, in addition to voluntary contributions as at present, and that they should be the subject of simultaneous discussion in the various local sections;

5. That the monthly *Proceedings* be extended to include abstracts and reviews of important engineering articles;

6. That advisory standing committees of the Board of Direction be created to promote the study of important engineering problems and to co-ordinate the work of the local sections;

7. That co-operation with other specialized engineering and allied technical societies be fostered and an active program of research work be encouraged.

The foregoing does not contemplate, as has been by some assumed, any restriction upon the distribution or discussion of technical papers which would then be presented when of interest to the local sections and there discussed orally, rather than as now, perfunctorily read in abstract to an indifferent assemblage in New York.

Question B-2. Shall local sections be created to embrace the entire membership of the Society? (Report Division B, Section 1, paragraphs a, b, c and h, p. 6.)

If, as is later proposed, the directors are to be nominated and elected by the districts which they represent, it becomes necessary to create an organization in each district to carry out that purpose, and no more satisfactory way of doing so has yet been suggested than that of assigning every member to a local section.

Question B-3. Shall the directors in each geographical district be nominated and elected by vote of the corporate members resident therein? (Report, Division B, Section 1, paragraphs e, f and g, p. 6.)

If memory serves the writer correctly this question was answered overwhelmingly in the affirmative in a previous questionnaire, but the then Board of Direction did not see fit to embody the idea in the proposed revised constitution.

Question B-4. Shall a portion of the Society dues be allotted to local sections? (Report, Division B, Section 1, paragraph i, p. 6.)

If the work of nomination and election of directors be carried out as proposed in Question B-3, funds must be provided to cover the necessary expenses. It is not contemplated that the allotment to the local sections will exceed the amount needed for this work, which has been estimated at less than $2 per member.

Question B-5. Shall the present Nominating Committee be abolished and candidates for the offices of president, two vice-presidents and treasurer be nominated by representatives of local sections in annual conference? (Report, Division B, Section 1, paragraphs j and k, pp. 6-7.)

It is proposed that representatives of the local sections shall gather in conference at the annual convention to discuss matters of society and section welfare and nominate the officers to be elected at large.

Question B-6. Shall the dues of all non-resident members above the grade of Junior be increased to provide for greater activities of the society, said increase not to exceed $5 per annum?

This question requires no explanation. Further money seems needed to carry out the work of the society in any event, but it is the belief of the writer that with an improved administration at headquarters, the maximum amount provided under this question will be sufficient for all contemplated needs.

Question B-7. In case it should be found that the activities brought about by the movement to expand both the internal and the external work of the society would require more funds than would result from the increase in dues contemplated in Question 6 of Internal Relations, would you favor increasing the dues of all non-resident members, above the grade of Junior, by an amount greater than $5 but not greater than $10 per annum?

Question B-7 was added by the Board of Direction and no comment will be made thereon.

GARDNER S. WILLIAMS,
Member of Development Committee, Am. Soc. C. E.,
and of Joint Conference Committee.
Ann Arbor, Mich.

Cement-Concrete and Bituminous Concrete in Highway Foundations

Sir—The article in your issue of Jan. 8, p. 96, "Sheet Asphalt—Ideas On Suitability of Varying Bases —Costs," by Captain F. S. Besson, giving Washington's half century of experience with pavements, is most timely and instructive. The low maintenance cost of these pavements up to 25 yr., and even longer, taken in conjunction with the low first cost, should be borne in mind by engineers who are searching for durable pavements for permanent highways. Owing to the fact that all sheet asphalt pavements in Washington have been laid under scientific supervision since 1876 and that there are full records of the composition of every pavement laid since 1894 and complete records of maintenance dating back to the early nineties, that city offers exceptional opportunities for the study of the great possibilities of this type of pavement.

The writer, however, cannot see wherein Captain Besson has proved, with the data presented, the superiority of cement concrete over bituminous concrete as a foundation for continuous bituminous surfaces. He says: "Ten years after the first period, or about 1888, determined efforts were made to obtain a base at less cost than the standard, and recourse was once more had to bituminous mixtures, using standard asphalt top for wearing surface." The so called bituminous base used at this time was not a bituminous mixture, but merely clean broken stone well rolled and then lightly sprinkled with melted coal-tar pitch. The specifications for this so-called bituminous base as given in the report of the operation of the Engineer Department of the District of Columbia for the fiscal year ending June 30, 1891, are as follows: Under "Combination Asphalt Pavement On Bituminous Base," Sub-heading "Base"—"The Base will be composed of clean broken stone that will pass through a 3-in. ring, well rammed and rolled with a steam roller, weighing not less than 5 tons to a depth of 4 in. The rolling will be continued until the stone ceases to creep before the roller and until it is evident the final compression has been reached. It will then be thoroughly coated with No. 4 coal-tar paving cement or its equivalent, asphalt cement, in the proportion of about 1 gal. to the square yard of base." Substantially these same requirements for this so called bituminous base are found in standard specifications back as far as 1887, and were likely used several years previous to this and the writer personally knows that they were used in some types of construction for several years after 1894.

This base, as actually constructed, was made with one size broken stone. Not only was no attention paid to the character and quality of the coal-tar pitch, but it was applied in the most crude manner by hand, and in such small quantities that there was often not enough to cover the surface stones. A foundation, such as this, is not as good as macadam and is far inferior to a bituminous concrete which is made by mechanically mixing graded broken stone and sand with asphalt cement.

There are, however, a number of cases in Washington where old coarse-aggregate bituminous pavements made by the mixing method have been utilized as foundations for the standard sheet asphalt wearing surface and binder. Such foundations are true bituminous concretes and it would be interesting to know how these pavements compare with pavements of sheet asphalt on cement concrete foundation. I believe the maintenance cost would be in favor of the bituminous concrete base. Two pavements of this type that the writer recalls are: Vermont Ave. between H and I Streets laid in 1878 and Massachusetts Ave. between 14th and 16th Streets, laid about 1903. The first pavement, 42 yr. old, is in excellent shape today and has cost exceptionally little for repairs and I believe the maintenance cost on the latter is very low.

There has been little or no bituminous concrete used for foundations for bituminous sheet pavement in the East, owing to the fact that it has been more expensive than cement concrete. In California and some western states where good asphalt can be obtained cheaply, it has been used very extensively and with good results. As to relative merits of portland cement concrete and bituminous concrete foundations, it is hardly fair to either to compare results obtained in any one city or locality.

There is no doubt but that under pavements laid over poor subsoils or where sub-drainage is bad, the cement concrete foundation is the better, but even then they are liable to fail and invariably develop cracks, which in many cases cause similar cracks in the asphalt wearing surface. With good subsoil and drainage conditions bituminous concrete is as good, and in many respects better, than cement concrete foundations. Especially is this true when the asphalt wearing surface contains a large mineral aggregate, for large stones are less liable to crush under traffic on a resilient bituminous concrete foundation than on a rigid cement concrete base. The bituminous concrete does not develop contraction cracks and it unites with the binder and wearing surface into a monolithic mass. This close union prevents the wearing surface from shoving on the bituminous base under excessive traffic as it is liable to do on the cement concrete base.

Captain Besson says at the top of p. 97: "In the first concrete bases, imported and American natural cements with very lean proportions, about 1 : 4 : 10, were used under the primitive method of 35 years ago." If any imported cement was used in cement concrete base in the early days, it was only in one or two exceptional cases. American natural cements were used exclusively until about the year 1900 (not 1893), when portland cement was substituted for use in concrete base for sheet asphalt pavements. The proportions used in the natural cement concrete base from the early days down to the time its use was abandoned was, 1 of cement, 2 of sand and about 5 of broken stone or brick. As Congress had established a low limit on the price which the District of Columbia was permitted to pay for sheet asphalt on 6-in. concrete base, it was necessary at the time of changing from natural cement concrete to portland cement concrete to have the price of the latter base about on a par with that of the former. It was found that portland cement concrete of 1 :4 :10 met this requirement and this mixture was adopted and used as a pavement foundation on all but heavy traffic streets for 6 years or more. The aggregate used in this lean concrete was either graded stone, such as run of the crusher, or a mixture of 5 parts gravel and 5 parts stone. There was just sufficient water in it to make a wet concrete, but still not sloppy. After placing, it required but little tamping to bring free mortar to the surface and, in fact, at times the surface of the concrete was smoother than desirable, showing that there was more than enough mortar to fill the voids.

No failures have ever occurred in one of these foundations and samples taken out in making service cuts through the pavement, showed the concrete to be free from voids and as strong as the average concrete base. They also showed fewer cracks than are found in rich concrete foundations. The excellent results obtained with 6-in. foundations made with this lean portland cement concrete are worthy of note, especially so, in view of the fact that some engineers are recommending concrete for pavement foundations mixed 1 cement, 2 sand, 4 aggregate and even richer.

Now, the writer does not wish to recommend the use of a 1 : 4 : 10 concrete, unless the engineer is certain that he can get a well graded coarse aggregate and be reasonably sure of getting the correct proportioning of materials.

He does however, wish to emphasize the fact that concretes 1 : 2 : 5 and richer are not only unnecssarily expensive but are undesirable for bituminous pavement foundations. It is well recognized that rich concretes are much more liable to crack than lean concretes and these cracks, not only weaken the foundations, but often cause corresponding cracks in the wearing surface. Concretes of the proportions of 1 : 3 : 6 or 1 : 3 : 7 are as rich as should be used and make the most desirable foundations. If greater strength is desired, the thickness of the foundation should be increased or suitable reinforcing used.

A. W. Dow,
New York City. Consulting Paving Engineer.

[Mr. Dow was formerly inspector of asphalt and cement for the District of Columbia.—EDITOR.]

Sir—1. It is apparently difficult to get the gist of what is advocated in the foregoing article relative to bases for sheet asphalt pavements. Experience has led the City of Washington to adopt as its standard a six-in. base of 1:3:7 portland cement-concrete, with gravel as the coarse aggregate. This standard is adopted because a rigid base is thus obtained as compared with a flexible one obtained by the use of macadam or bituminous macadam.

2. No attempt has been made to compare bituminous concrete with portland cement-concrete, the excessive cost of the former in a base of sufficient thickness to support properly a sheet asphalt pavement makes a comparison unnecessary.

3. Of the original surface of Massachusetts Ave. as quoted by Mr. Dow, practically none remains today. Vermont Ave. on the other hand is still giving excellent service, the reason being that the base of eight to ten in. of rich bituminous concrete underlaid with six in. of sand and gravel has formed a rigid support for the asphaltic surface. For the same reason—rigidity—hydraulic cement-concrete bases are excel'ent. While Vermont Ave. with its bituminous concrete base is an isolated instance, numerous pavements with hydraulic cement-concrete bases may be cited as examples, pavements comparable with Vermont Ave. as to age and traffic and averaging less than 2c. per sq.yd. per year maintenance during the past decade.

4. Through a telford or any old macadam pavement with sufficient rigidity may be an excellent base for an asphalt pavement, hydraulic cement-concrete, if for any reason it fails to provide sufficient rigidity, may prove to be a poor base. During the past working season in Washington Twenty-third St., E. to Virginia Ave., and Florida Ave., Q to R Sts., were resurfaced. When the asphalt was stripped from the base it was readily seen that the relatively poor service given by these two pavements was due to the non-rigidity of their bases. The concrete base on Twenty-third St. was laid in 1900 using a natural hydraulic cement. Florida Ave. was laid in 1895 likewise using a natural cement. The specifications covering this latter base is interesting:

"The mortar shall be composed of 300 lb. of cement and two bbl. of loose sand. To the mortar, broken stone, or equal parts of broken stone and gravel, shall be added in such proportions that the resulting concrete shall contain for every 300 lb. of cement and two bbl. of loose sand such proportion of broken stone as to give a slight surplus of mortar when rammed."

Today it is impossible to learn just what proportions were used. Of course, the concrete was mixed by hand. During the resurfacing work, one base was taken out with a horse and plow and a steam shovel ripped out the other with ease. The bases were replaced with the standard 1:3:7 portland cement gravel concrete.

5. As now laid Washington concrete bases are expected to have an indefinite life. On an average of 25 years service they will be resurfaced with a new 3-in. sheet asphalt pavement. The ease with which worn-out pavements may be stripped from the base is an advantage in favor of portland cement-concrete, and the adherence of the sheet asphalt to the bituminous base is one of the disadvantages of the latter. Years ago in resurfacing pavements with bituminous bases the new pavement was laid directly on the top of the old. This has proven unsatisfactory and during the past 15 years worn-out sheet asphalt pavements with bituminous bases have always been taken out entirely and replaced by portland cement-concrete bases and a 3-in. sheet asphalt surface.

6. A richer mix than the 1:3:7 standard would undoubtedly give better service but not to such an extent as to warrant the difference in cost. Washington one-course concrete pavements, 1:2:3 mix, now being laid, are placed at such a grade that they may be at some future date surfaced with a sheet asphalt pavement. Given a base of sufficient rigidity the pushing and cracking of the sheet asphalt surface is due either to faulty surface mix or construction. By proper methods it is possible to obtain a pavement that will neither push nor crack. It is the aim of the Highway Division of Washington to average 500 patches per day in its sheet asphalt maintenance work during the next few months. By following the patching gangs in this work it may become evident to any one that cracks and other defects in the sheet asphalt surface have absolutely no relation to so-called expansion or construction cracks in the portland cement-concrete base.

F. E. BESSON,
Captain, Corps of Engineers, U.S.A.
Washington, D. C.

Railway Employees' Wages and the Cost of Living

Sir—In an interesting article appearing in your issue of Feb. 19, p. 385, Charles Whiting Baker questions the statements made by the American Institute of Consulting Engineers in its communication to the president, dated Aug. 19, 1919. Indeed, he even goes further and states that we were led into an error in respect to the cost of living because we used the figures of the National Industrial Conference Board. Coming from a gentleman so well informed and so well known

as Mr. Baker I am required to defend our statistics. It is seldom if ever that I am in disagreement with Mr. Baker's conclusions, but in this particular instance I maintain that we used, as a basis of the cost of living, less debatable figures than Mr. Baker has.

When the startling statements of the Railroad Brotherhoods appeared in the public press of Aug. 3, 1919, our executive committee felt that the voice of at least one unit of the profession should be immediately heard in answer to these statements. In preparing our statement or memoranda to the president the latest available figures as to the increase in the average compensation received by railroad employees were as of January, 1919, and March, 1919, respectively. The authority for the figures for the average monthly wages per man of all railroad labor was obtained from the Operating Statistics Section of the United States Railroad Administration for the years 1917 and 1918 and from the published reports of the Interstate Commerce Commission for the years 1914 and 1917. These figures showed an increase in the monthly wages between 1914 and 1919 of 92 per cent. Since the issuance of our statement later figures from the Director General of Railways show the average monthly earnings of all railroad employees to July, 1919, as $121.50 or 4 per cent less than in January of the same year. The monthly wage for a summer month would naturally be lower than the average for the year, owing to the employment during the summer period of a relatively greater amount of cheaper labor.

For the cost of living, we had before us the figures of Dun's "Index Numbers," the Department of Labor and the National Industrial Conference Board. It was found that Dun's figures showed the wholesale cost of 200 commodities and evidently did not take into consideration the consumption of the items, nor did it completely take into consideration shelter and some sundries. The figures of the Department of Labor were found to be the average between 18 "shipbuilding centers" and for cities and towns other than these centers, the average increase being obtained by dividing the two. On the other hand, it was found that the statistics of the National Industrial Conference Board covered a wide range of cities, completely included the family budget, and in our opinion was more representative of the cost of living than the other two authorities. We, therefore, accepted such as the best evidence of the increase in the cost of living. This showed that for March, 1919, the cost of living had increased 61 per cent.

In October the figures for July, 1919, were obtainable from both the National Industrial Conference Board and the Department of Labor which showed increases of 70.8 per cent and 75.2 per cent, respectively. The latest bulletin of the Industrial Conference Board shows, as Mr. Baker states, that the cost of living had increased to 82 per cent on Nov. 1, 1919, and the increases shown by the National Industrial Conference Board practically parallel the figures of the Department of Labor. The result of the latest comparable figures, namely, those of July, 1919, shows that the railroad wages had still increased more than the cost of living. It is undoubtedly true, however, that the curve is showing that the increase in the cost of living is now approaching the increase in the average monthly wages of all railroad employees. Personally, I doubt that the former will cross the latter because some increases have recently been granted railroad labor, and if we may trust our public officers in Washington, the cost of living has reached its peak.

F. A. MOLITOR,
Secretary American Institute of Consulting Engineers.
New York.

The above letter has been submitted to Mr. Baker, who replies as follows:

"The cost of goods mounts faster than the wage level," was the statement made by the Railway Brotherhood heads which the Institute of Consulting Engineers declared to be false.

As for the relation of the Dun index number of wholesale prices to the cost of living, it is true that the commodity list does not include the items of house rent and service; but these amount, in the living expenses of the man earning $116 a month (the average earnings of all railway employees in the first six months of 1919) to only about one-fourth of the total family expenses; and rents as well as prices of goods were raised all over the country in 1919. The index number of wholesale prices, moreover, takes no account of the heavy burden on railway employees and all the rest of us due to the raising of retail prices farther and faster than wholesale prices.

Dun's index numbers of wholesale prices are based on the quotations in the wholesale market of about 300 staple commodities. In making up the index number these are weighted on a per capita consumption basis. The Dun numbers show a considerably lower and more regular curve than the similar index numbers issued by Bradstreets and by the Bureau of Labor.

The Institute of Consulting Engineers issued its diagram purporting to show the relation between increase in railway wages and increase in cost of living August, 1919. It was unfortunate to use at that time figures for the cost of living in March, as that was the month when prices were at the lowest in the lull of business following the armistice and by August, prices had risen to a height exceeding the highest level of the war. Further than that, prices have gone on climbing ever since. The following are the Dun index numbers of wholesale prices for the past 12 months:

1919	March 1, ...	$217,037	1919	Sept. 1, ...	$238,342
	April 1, ...	219,973		Oct. 1, ...	235,867
	May 1, ...	222,193		Nov. 1, ...	238,573
	June 1, ...	222,973		Dec. 1, ...	244,639
	July 1, ...	233,707	1920	Jan. 1, ...	247,394
	Aug. 1, ...	241,650		Feb. 1, ...	253,748

The average for the year 1913 of the Dun index numbers was $120.90; hence the wholesale prices of commodities on Feb. 1 had increased 109 per cent over the average of 1913. The very rapid increase in rents during the past twelve months in all parts of the country is well known. Fortunately present appearances indicate that the summit has at last been reached and that a considerable drop in prices may be expected during the current year.

It is only fair to add that railway employees' wages were not advanced during 1919 to correspond to the increase in living costs. Such wage increases as were made were comparatively small.

The report of Director-General Hines just made public, with the official figures, bears out well the position taken by the writer in the article discussed by Mr. Molitor.

CHARLES WHITING BAKER.

A Single National Engineering Society With Locals and Special Sections

Sir—With the great growth of the American Society of Civil Engineers and the other large technical organizations generally classed as "Engineering," come problems not readily solved, nor to be easily separated into two classes, "Conservative" and "Radical," as some would try to do. In the mad rush to make money, and the perfectly justifiable desire to secure a scale of remuneration commensurate with worth of service, too many are seemingly ready to throw overboard the high standards which underlie the four avocations, usually called professions: Theology, Medicine, Law and Engineering, the application of the respective God-given principles to human betterment.

The engineer should occupy a far bigger field in world affairs, and he will in spite often of too much modesty, and his organizations, technical as well as others, must reflect and stand for such participation, but labor unionism, useful as that is when properly controlled, must not be permitted to dominate the activities of the great technical societies which should stand for dissemination of knowledge, approval of the sound and rejection of the false.

For well over 30 years the writer has been in the American Society of Civil Engineers, passing through its various grades. While generally resident in New York, he has had occasion to be more or less familiar with engineering conditions in many parts of the United States and in other lands, and has maintained a keen interest in the society throughout. Rightly or wrongly, in the past ten or fifteen years, there has grown up an unmistakable sentiment that that society had developed into a huge local organization, not entirely local in membership, but actually local in interest.

Under date of Jan. 22, 1912, following a very successful annual meeting, the writer sent a letter to the Board of Direction, raising the point for discussion at the next annual meeting of thereafter abandoning them as such and the formation, at once, of more local societies throughout the country, from which delegates could be sent to general business conferences. The argument was largely based upon the proportions of resident and non-resident members in attendance at annual meetings for several years previous. The secretary of the society took issue with the point, and it went no further, until recently an almost identical policy has been promulgated, and carried even further than had been in the writer's mind in 1912.

The local societies have not been used to best advantage; even the growth of a few of the larger ones has not conduced to the prestige and welfare of the national organization. There should be no Boston Society of Civil Engineers, or Western Pennsylvania, or Western Society in Chicago, as separate incorporations, but these and others should be locals of what might soon become an international society in fact, if perchance not in name. There should be no separate water works association, or societies for testing materials, or those for municipal improvements.

Let the local societies fill the fields, discuss papers, from which those worthy of full publication could be selected for issue by the main society. Let the locals participate in civic affairs, not in an undignified way, but with the broad power of trained men, to help. Then, for acquaintance sake, hold conferences at various places through the country, as the annual conventions have been held hitherto, combining delegated business and social intercourse, not simply a golf match or a card party and dance, pleasant and appropriate though they may be as adjuncts. The President, as one of his duties, should visit the locals, not alone for a social call but to gather data as to their problems, operating and technical, so that at the meetings of the Board of Direction and the annual assembly or convention, intelligent consideration could be given, with first-hand knowledge.

Some day we may achieve the ideal of one great Engineering Society, with working locals, subdivided into special sections, giving greater economy of time, as well as very largely of expense, not perhaps honoring so many big and little presidents, directors and secretaries, but making membership worth while. The topic is a fruitful one for rambling comment, but space in a technical journal is not unlimited.

Let us advocate growth, expansion, development of the highest possible engineering, but not throw away the high professional standing which has attracted membership in spite of some resentment of what may be called ultra-conservatism.

LOUIS L. TRIBUS.
Member, Am. Soc. C. E., and too many other organizations.
New York

Longer River Distance Important in Comparing Freight Rates

Sir—I wish to call attention to one fact of importance in studying waterway transportation, which was not clearly stated in Charles Whiting Baker's series of articles in your January issues. In the Jan. 29 article, p. 241, in estimating the possibilities of economical transportation on the Mississippi River from New Orleans to St. Louis, he puts the probable cost of such movement at one mill per ton-mile, which is near enough correct to be allowed to pass unchallenged. However, he fails to call attention just here to the fact that the mileage by river is 1,200 mi. as compared with 700 mi. by railroad, so that the rate of one mill per ton-mile by river would be equal to 1.7 mills per ton-mile by rail, which, as he shows in another place is a rate that has already been equalled by the railroads. There is, besides, the disadvantage of 50c. per ton for the transfer at St. Louis from river to rail. Furthermore, the population of St. Louis is only about one million (maybe less) whereas the territory that could be reached by railroads in Mississippi and Ohio river valleys without transfer, and at no greater distance from New Orleans than St. Louis must be several millions.

The importance of conserving capital at this time, when so much of the world is at point of starvation, makes it worth while to criticise every proposed plan that is vulnerable if the amount to be spent on it is considerable. Those backing this project should give reason for the faith that is in them and show clearly where it will be cheaper than transportation by railroad.

JOHN WILKES,
Civil Engineer.
Nashville, Tenn.

Water Consumption at Washington, D. C.

The average daily per capita water consumption of the District of Columbia has been reduced from 175 gal. for the fiscal year 1911-12 to 156 gal. for 1918-19. It fell to 145 gal. in 1915-16 and has risen steadily since. The 1918-19 consumption is figured on an estimated population of 417,405.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Temporary Power Station Aids in Hydro-Electric Development

BY THOMAS C. HIGGINS
Norfolk, Va.

THE accompanying photograph shows the plant used to furnish power for reconstruction purposes on a hydro-electric development in Maine. The site was so situated that current could be obtained only at considerable expense, and the distance from a railroad made the cost of coal high. To furnish power for construction it was decided to install temporarily a waterwheel and penstock that were to be used later in a small

TEMPORARY WATER WHEEL INSTALLED TO FURNISH POWER FOR CONSTRUCTION

neighboring development. This plant was installed on the stream in such a way as not to interfere with the main development. Water was carried to the wheel in a wooden flume 250 ft. long and a wooden penstock 200 ft. long. A head of 30 ft. was secured and enough power developed to run the mixer, derricks, cableway, etc. The entire plant was operated with little expense and worked very successfully.

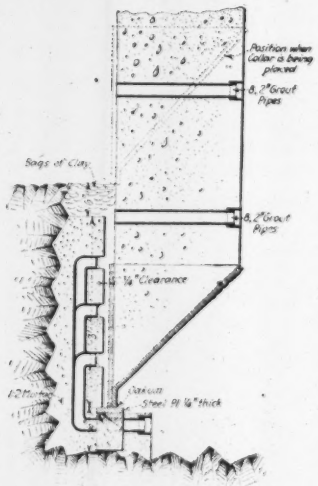
Drilling Holes in Frozen Ground

BY L. G. HALL
Construction Engineer, N. Y. City

A GREAT deal of grading during the cold weather had to be done for the new automobile factory which the Willys Corporation is building at Elizabeth, N. J. The surface of the ground had been covered with a frozen crust too thick to be broken by the steam shovel, and which had to be broken up by blasting before it could be taken away. This brought up the question of drilling the blasting holes through the 18-inch frozen crust. A simple, yet very effective method of doing this was by heating steel bars to a low red heat in an ordinary salamander, and driving them into the frozen ground with hammers. A number of bars were kept in the fire at a time, so that there was no delay while waiting for them to heat. Usually a bar would penetrate 10 or 12 in. under 20 or 25 blows with a light sledge, before cooling. Then a second hot bar would be inserted and the hole completed. A piece of gunny-sacking was laid around the bar on the ground before driving, to confine the sputtering when the red hot bar came into contact with the ice. Some time was also saved when cold weather was foreseen, by driving holes into the then soft earth with an ordinary bar, and plugging them up with straw. When it came time to blast in frozen weather, any water in the holes was melted out by a hot bar without hammering, and the charge inserted. While this method of driving holes in frozen ground is by no means new, it is not nearly as frequently resorted to as could be done with advantage.

Concrete Caisson Seat in Rock Grouted Water-Tight

WATER-TIGHT seats were secured by grout injection into prepared channels in sinking caissons through earth to a seat in ledge rock when constructing shafts for the City Tunnel through the Catskill water supply for New York, N. Y. When the caisson had reached rock level, as indicated by the dotted lines in the drawing, it was held while the excavation was continued into the ledge to sound rock. On the rock bottom 6 x 6-in. wood blocks, capped with steel plates, were set to level at 4-ft. intervals around the perimeter. A mortar collar, with an imbedded pipe system, was then molded in place behind circular forms. Inside surface grooves were formed by nailing half-round strips to the forms. Besides the horizontal grooves indicated, there were vertical grooves every 6 ft. around the ring. Six pipes, arranged around the ring end embedded in the collar, opened two into each horizontal groove. With the collar completed, a 5-in. cushion of oakum was attached to the cutting edge and the caisson was dropped inside the collar onto the concrete seat. Finally grout was forced in, filling the grooves and pipes and all spaces between the collar and the caisson. This seal was successful. The leakage at the deepest shaft, where the head was 100 ft., was only 7 gal. per minute and subsequent grouting stopped this inflow. The grout pipes through the caisson above the collar were designed for injecting grouting into the sand above the rock. It was found that only slight consolidation of the sand above could be effected by grouting. This description is taken from a paper, "Grouting Operations, Catskill Water Supply," by James F. Sanborn and M. E. Zipser, in *Proceedings*, American Society of Civil Engineers, January, 1920, p. 3.



GROUT SEALING CAISSON IN EARTH TO ROCK

NEWS OF THE WEEK

New York, March 11, 1920

Six Lines of Traffic Demanded for Hudson Tunnel

Provision of width adequate for three lines of traffic in each direction was demanded by New Jersey interests at the third public hearing on the plans for the Hudson River vehicle tunnel (*Engineering News-Record*, Feb. 19, 1920), held at Newark, N. J., on March 4. Morris R. Sherrerd, city engineer of Newark, and H. C. Eustice, of the Newark Traffic Club, advocated the increased width. E. A. Byrne of New York, member of the Board of Consulting Engineers for the tunnel, presented a minority report disapproving several stipulations of the official plan for two 29-ft. cast-iron tunnels, among them being its capacity. He urged that the capacity of the accepted design has been overestimated and that a pair of three-line tunnels would approximate the traffic-capacity which the engineering studies showed to be desirable.

On the matter of type of tunnel, important statements were read by General George W. Goethals and Colonel William J. Wilgus, the latter officially representing the Board of Consulting Engineers. General Goethals' statement was said to have no reference to the criticisms of his 1917 recommendation in favor of a 42-ft. concrete block tunnel, contained in a report of Chief Engineer Holland (see *Engineering News-Record*, March 4, 1920, p. 490).

The general stated that concrete is a more economical structural material than cast iron, that the single tunnel is more economical than two, and that no reason is apparent why the air pressure in a shield cannot be varied to suit the face pressure, as proposed for the 42-ft. tunnel. He cited evidence tending to show that the Hudson silt is a relatively stable material, and that a brick tunnel has existed in it for many years. Also the history of this same tunnel shows that shield work is more costly than air work without shield. Finally, General Goethals argued against too close a following of precedent, saying that followers are in the great majority, while leaders are few. The promised saving of over ten million dollars by concrete in place of cast-iron tunnel construction is too great to be ignored.

Colonel Wilgus declared that the material to be encountered in the Hudson is among the softest clays of the entire region. Citing stress analyses made under specified assumptions, he gave the greatest compression and tension in the Goethals concrete tunnel lining (3 ft. thick) as 1,000 lb. and 400 lb. per sq.in., respectively, and the lug shear as 1,192 lb. per sq.in. He

(*Concluded on page* 544)

To Control Power During California Drought

Sixteen Companies and City of Los Angeles To Operate Under Rules of Railroad Commission

By Telegraph from Engineering News-Record's Pacific Coast Editor.

Sixteen California power companies and the City of Los Angeles have signed an agreement requesting the Railroad Commission to make and pledge themselves to abide by rules of service for the distribution of electrical energy during the emergency created by a season of unprecedented drought following two very dry years. (See *Engineering News-Record*, Feb. 26, p. 429, for some details of the water shortage.) The diminution or refusal of service and the exchange of energy between power companies will be covered by the rules as well as co-operative plans for preventing waste. Under the auspices of the Railroad Commission there has been formed an emergency water conservation conference composed of Federal and state officials who have expert knowledge of the water resources of California and of the extent of the present menace.

This conference includes the following members, all acting in their official capacities: W. F. McClure, state engineer; Frank Adams, California Branch, Irrigation Investigations, U. S. Department of Agriculture; E. H. Heck, Director State Department of Agriculture; C. H. Lee, State Water Commissioner; H. D. McGlashan, U. S. Geological Survey; H. D. Butler, State Power Administrator; Lt.-Col. L. H. Rand, Corps of Engineers, U. S. A.; H. D. Loveland, Chief Hydraulic Engineer, State Railroad Commission.

The purpose of the conference, which is headed by E. O. Edgerton, president of the Railroad Commission, is "to secure for the power and water users of the state the greatest benefits from the available water and power and to reduce to a minimum the damage resulting from the water scarcity." A list of suggestions addressed to all large users of power or water for irrigation has been sent out and plans for the greatest care in inspection and fair apportionment of all waters are under way. A series of meetings in various cities of the state has been scheduled. Weather Bureau observers report that the ground water level is the lowest ever recorded and that the past January was the dryest in seventy years.

Coming—An Important Railroad and Earthwork Article

Space limitations prevented the use in this issue of an article on the construction of a heavy industrial railway, involving unusual experiences with earth pressures over a 50-ft. arch culvert. Railroad engineers and all interested in heavy earthwork will do well to look for the article, which will appear in *Engineering News-Record* March 25.

Cohoes Bridge Fails as Wood Flooring Burns

Failure of the Cohoes-Lansingburgh bridge over the Hudson River a few miles north of Albany, N. Y., a wrought-iron structure of five spans having a total length of about 700 ft., occurred March 4 as the result of a fire in the creosoted wood block floor system caused, it is believed, by a short circuit on the trolley car line which the bridge carried. Weakened by the heat of the burning floor system three spans collapsed and fell into the river, forming an obstruction which, it is feared, may cause an ice jam.

Referendum on Public Works Bill Being Taken

The National Federation of Construction Industries, through its legislation and financial operation committees, is taking a referendum vote on two measures now being considered by Congress; the Jones-Reavis Bill, proposing the establishment of a Federal Department of Public Works, and the proposed amendment to the Federal Reserve Act. The Advisory Board of the National Federation of Construction Industries, composed of 153 members representing all sections of the United States and all lines of construction and allied business, has displayed a sentiment favorable to the establishment of a National Department of Public Works.

Mechanical Engineers To Have Professional Sections

The Council of the American Society of Mechanical Engineers has authorized the establishment of professional sections in the society, and steps are being taken to organize sections in aeronautics, cement, fuel, gas power, industrial engineering, machine shops, ordnance, power, railroad, and textiles. It is intended that the sections formed of mechanical engineers in the forego-

ing several fields will form the nucleus for further sectionalizing of the society along the lines in which any interested group of specialists may become interested and make application.

The society is now balloting upon an amendment to its constitution which would provide a standing committee on professional sections. The differentiation between local sections and professional sections is the same as that between community interest and professional specialty. There is to be no additional assessment on members for participation in the professional sections.

Six Lines of Traffic Demanded for Hudson Tunnel

(*Concluded from page* 543)

criticized the absence of connection between voussoirs of the block lining rings as a fatal defect. On the score of cost, he offered figures to show that under the best conditions the operation of the Goethals tunnel would represent an excess capitalized cost of over thirty million dollars.

J. F. O'Rourke submitted cost estimates for a pair of 31-ft. concrete tunnels, in comparison with estimates on the official plan, the former being about half the latter. W. C. Parmley argued for the practicability of concrete-block construction, basing on 15 years of experience with concrete block tunnels. St. John Clarke offered to bid on an alternate plan which he claimed would save several million dollars and a year of time. J. C. Meem proposed three alternative methods by which a large tunnel could be constructed, and estimated a year's saving of time as compared with requirements of the official plan.

Edward Wegmann, P. G. Brown and others supported the official plan and argued against alternative bids. J. K. Thomson and others advocated trench-tunnel construction.

Contracts Let for Six Staten Island Piers

Work is to be started within a month on the New Staten Island terminal pier development planned by the City of New York. Contracts for the construction of six of the twelve piers planned were let on March 5 and the Board of Estimate on the same day approved plans and the form of contract for the remaining six the same day. The piers are located on the northeast shore of Staten Island, inside the Narrows in the Upper Bay and between Tompkinsville and Clifton. They are between 1,050 and 1,120 ft. long, and ten of them are 125 ft. wide, while two are to be built 209 ft. wide to carry freight-handling machinery outside the sheds, a design demanded by the lessee. The current contracts are: Dredging, Morris & Cumings Dredging Co., $628,800; piers and substructures, Terry & Tench, $3,252,570; superstructure, Bethlehem Steel Bridge Corporation, $2,577,950.

Pittsburgh Civils Say Architects Should Not Design Bridges

In accord with the action of several other Pennsylvania engineering societies, the Pittsburgh Association of Members of the American Society of Civil Engineers, at a recent meeting, unanimously adopted a resolution prepared by J. N. Chester, W. M. Judd and N. S. Sprague, condemning the employment of architects to design large bridge structures, as was done in the case of Allegheny County, Pa. (see *Engineering News-Record*, Oct. 9, 1919). The resolution follows:

Whereas, The commissioners of Allegheny Co., Pa., have awarded contracts to certain architects for the design and supervision of construction of certain bridges over the Allegheny River, and

Whereas, The work involved in these contracts is primarily engineering with respect to both cost and design, and

Whereas, undesirable precedent is being established for the guidance of various public authorities in awarding contracts for the design and supervision of the construction of bridges to architects, and

Whereas, The continuance of such practice will subordinate the engineering profession, thereby rendering the safety of the public, economy of design and the utility of structures secondary in importance to aesthetic features, and

Whereas, It appears desirable that the extent of the work and responsibility of both the engineering and architectural professions be clearly defined, therefore be it

Resolved:

(1) That the Pittsburgh Association of the American Society of Civil Engineers direct the attention of the county commissioners to the above facts and dangers;

(2) That for the bridges yet to be built care shall be exercised to put the responsibility for the design and supervision of construction in the hands of competent engineers as advisors to the county engineer;

(3) That the latter be directed by the county commissioners to exercise full authority for the inspection of construction for the two bridges now being designed and about to be erected;

(4) That architects and engineers shall collaborate to the end that art and aesthetic taste shall receive consideration at all times in the treatment of design and construction;

(5) That a copy of these resolutions be transmitted to the commissioners of Allegheny Co., the Board of Public Buildings and Grounds at Harrisburg, to the Philadelphia Section of the American Society of Civil Engineers, to the Philadelphia Engineers' Club and to the Engineers' Society of Pennsylvania at Harrisburg;

(6) That the Pittsburgh Association of the American Society of Civil Engineers is of the opinion that a policy should be determined between the American Institute of Architects and the American Society of Civil Engineers, defining and classifying the character and nature of architectural and engineering work, upon which architects or engineers or both should be engaged;

(7) That the Pittsburgh Association of the American Society of Civil Engineers request the Board of Direction of the Society to consider these resolutions in the light of the best interests of the engineering profession, and to request Engineering Council to confer with the American Institute of Architects to the end that such a definition be formulated and incorporated in the code of ethics of both societies.

Government Waterway Operation Under General Hines

Announcement has been made by the War Department that the inland waterways operated the last two years by the Railroad Administration will be now in charge of Brigadier General F. T. Hines, chief of transportation service, U. S. A. The order reads as follows:

"Under the terms of the Railroad Bill approved by the President Feb. 28, 1920, all boats, barges, tugs and other transportation facilities on the inland, canal and coastwise waterways acquired by the United States during the period of Federal control of transportation facilities were transferred to the Secretary of War, who was required to cause them to be operated and to assume and carry on all contracts in relation thereto. The Secretary of War has assigned the duty of the operation of the vessels noted to Brig. Gen. Frank T. Hines, now charged with the operation of all water, rail and animal-drawn transportation of the War Department.

"The facilities turned over are divided into two divisions: One division consists of tug boats and canal boats which operate between Buffalo, N. Y., and New York City, and Long Island Sound via the New York State Canal and Hudson River. This division is not operated during the winter months due to the waterways being closed by ice. It will probably be open for navigation in May. The other division consists of tug boats and canal boats which operate on the Mississippi River from St. Louis to New Orleans and to the Warrior River, near Birmingham, Ala. This division operates throughout the year. The control of terminal facilities for these two divisions is also provided for under War Department operation. No property pertaining to the canal proper has been taken over by the War Department; it controls only the equipment acquired during the time transportation facilities were under the control of the Federal Government.

"The control of these transportation facilities was taken over at 12:01 a.m., March 1, 1920, preliminary arrangements having been made with the office of the Railroad Administration which

has been handling this feature of the work. For the present, the personnel which was employed by the Railroad Administration will be continued on the same work, no changes being contemplated until the matter has been gone into thoroughly by the War Department. The only officer under the Secretary of War who is now directly connected with these inland waterways is General Hines."

New York Central Wins Suit for Shorter Span Across Hudson

Through a decision in the New York State Court of Appeals, on March 2, the New York Central R.R. was sustained in its contention that it not be required to use a 1,000-ft. clear span in its plan to detour traffic by crossing the Hudson River at Castleton, N. Y. The court held that the Federal Government, which had already authorized the construction of a bridge with maximum span of 600 ft., has authority superior to that of the State governing the use of lands under navigable waters. The effects of the State law requiring the construction of a bridge with a 1,000-ft. clear span were outlined in an article showing the location and general design of structures under the two plans in *Engineering News-Record* of May 30, 1918, p. 1033.

The State law against a bridge of only 600-ft. maximum span followed objections of interests in the City of Albany, based on the claim that a pier in the river would be an obstacle to navigation, but this plea was rejected by the Secretary of War after it was shown that the design proposed by the railroad company would not impair the channel.

While it is not expected that the case will be carried to the United States Supreme Court, there is pointed out the possibility of a writ being granted permitting such an appeal by the State

Power Unit of Government Picric Acid Plant Sold

The power unit of the Government picric acid plant at Little Rock, Ark., has been sold to the Arkansas Power & Light Company by whom, it is understood, power will be made available for the irrigation of 1,000 sq.mi.

The power plant was sold separately from the other units by E. C. Morse, Government director of sales, after he had rejected a $500,000 high bid on the entire plant. The cost to the Government of the whole was $6,700,000. The remaining units will be sold in parcels according to purchasers' requirements in order to realize a maximum price on the whole.

In negotiating the purchase H. C. Couch, president of the acquiring company, agreed to supply the power needs of all purchasers of the great plant's remaining units. In addition the company expects to have surplus power for pumping plants to irrigate more than 600,000 acres of rice.

Lt. Col. Deakyne Member Mississippi River Commission

Lieutenant Colonel Herbert Deakyne, one of the new members of the Mississippi River Commission, has a distinguished record of service as an engineer officer in the United States, the Philippines and in France.

Having graduated at West Point in 1890, Lieutenant Colonel Deakyne has served on the California Debris Commission and on fortification work and river and harbor improvements in Florida, Pennsylvania, Delaware and

LIEUT. COL. HERBERT DEAKYNE

the Philippines. He has been in charge of the Fourth Lighthouse District, U. S., and of the lighthouse work in the Philippines. As a capitain he commanded the First Battalion of Engineers in 1904-5. In 1909 he became a member of the board of engineers for rivers and harbors.

In command of the 19th Engineers and as colonel, National Army, he landed in France Aug. 30, 1917. Colonel Deakyne was later commissioned a Brigadier General, U. S. Army. He served in France as director of the Department of Light Railways and Roads, as a corps chief engineer and as chief engineer, Second Army.

Milwaukee Opens Electric Operation on New Division

On March 5, the Olympian Limited left Seattle as the first electrically operated train over the 265 miles of the new Othello-Seattle-Tacoma Cascade electric zone of the Chicago, Milwaukee & St. Paul Ry. A brief illustrated description of the large electric passenger locomotives for this service appeared in *Engineering News-Record* of Dec. 11-18, 1919, p. 1034. The locomotives described were built by the General Electric Co. and others have been built by the Westinghouse Electric Co.

No Appropriation Made for Barge Lines Operation

In view of the fact that the new railroad law specificially instructs the War Department to continue the operation of the Government's barge lines on the Erie Canal and the Mississippi and Warrior Rivers, the Department will borrow from its funds such money as may be necessary for these operations until Congress supplies the necessary appropriation. The railroad act authorized no appropriation for the operation of these barges.

The War Department's activities in connection with these transportation lines will be under the direction of General Frank T. Hines, the assigning order being quoted elsewhere in these columns. General Hines has not worked out a plan of administration as yet. For the present the same form of organization as employed by the Railroad Administration will be continued. Requests have been made by those interested in barge lines that their immediate direction be placed in the hands of civilian transportation specialists.

Commerce Commission Calls Value and Rates Hearing

The Interstate Commerce Commission, March 4, issued an order citing the rate-making provisions of the new Interstate Commerce Act and calling for a hearing on March 22. The questions for discussion, as outlined by the Commission, are: Whether, for purposes of rate-making, the carriers of the country shall be considered as a whole or divided in groups; what methods should now be employed for determining "aggregate value," whether as a whole or grouped.

Milwaukee Harbor Plans Accepted

Plans for a $5,000,000 water and rail terminal in the city of Milwaukee have been accepted by the City Harbor Commission. These plans have been prepared by H. McL. Harding, consulting engineer to the commission. They call for the improvement of the lake front from Wisconsin St. south to the harbor entrance, and of sewage disposal south of Wilcox St. Both the inner and outer sides of Jones Island will be improved.

Technology Clubs Associated To Meet in Philadelphia

The Technology Clubs Associated will hold its annual meeting at the Drexel Institute, Philadelphia, March 26, 27, 1920. The association was formed, with the approval of the officers of Massachusetts Institute of Technology, by graduates' clubs to promote closer co-ordination of engineering education with industry. Among the speakers are: Hollis Godfrey, Louis F. Musil, Samuel P. Capen, B. A. Franklin, Henry M. Waite and G. R. Wales.

Conferees Agree on Bill Transferring War Supplies

Final agreement by the Senate and House conferees on the bill, specifically directing the Secretary of War to transfer certain surplus property to the Bureau of Public Roads, for distribution among the state highway departments, will make available much additional road building material for transfer. The legislation will not have a decided effect on the transfer of motor vehicles as the War Department, for some time, has been making these deliveries as rapidly as circumstances would permit.

The bill, as agreed to in conference, contains an amendment providing that any state highway department may rent assigned equipment to any state agency or municipal corporation for road construction or maintenance at a "fair rental which shall not be less than the cost of maintenance and repair of said vehicles and equipment." The Bureau of Roads has no objection to these vehicles being made available for use on projects other than those receiving Federal aid.

While the present legislation makes available industrial railway equipment, donkey engines, concrete mixers, clam shell buckets, cranes, and much other machinery and supplies, Thomas H. McDonald, the Chief of the Bureau of Public Roads, feels that the list of materials could, with benefit, be expanded to include machine shop units, motor-mounted, locomotive cranes and TNT.

Hearing on St. Lawrence River Development

About 40 delegates from all sections of the Middle West and Eastern Canadian provinces, attending the first public hearing at Buffalo, March 1 and 2, before the International Joint Commission on the proposed development of the St. Lawrence River, made a much greater impression in favor of the scheme than did the opposition to the project offered by delegates from the western section of New York State. The expected opposition by the coal interests who sell Northern New York and Canada and the trunk line railways which tie the Atlantic seaboard to the Northwest did not develop openly. If such opposition was offered the interests were represented by New York State delegates, who opposed the plan principally on the grounds that the Barge Canal would become obsolete and that Buffalo, Boston, Baltimore, New York and Philadelphia shipping interests would suffer. However, there were no accredited representatives from the places mentioned with the exception of Buffalo, which opposes the project bitterly.

One of the typical arguments in favor of the navigation development of the Canadian waterways was about as follows: "We are facing a transportation emergency in the West. Crops are rotting because we cannot ship them and the West is not one-quarter developed. Development of the St. Lawrence River will release 40,000,000 tons of coal which is burned today in generating electric power, 40,000 miners to other industry and line the banks of the Erie Barge Canal with industries. One-half of the cost of transporting a bushel of grain from Duluth to Liverpool is spent between the time the boat docks at Buffalo and leaves the dock at New York." The Western delegates came from Detroit, Chicago, Ashtabula, Superior, Akron and several other West and Middle West cities.

The opposing delegates from Buffalo, Rochester, Utica and other Western New York points, declared that the project, if put through, would cost the United States $100,000,000 and that it would necessitate the dredging of Lake Erie and all canals in the Great Lakes system. They claimed that a special type boat would be necessary and that grain and ore could not be carried to economic advantage.

The meeting opened March 1 and closed the afternoon of March 2. The full joint commission was present. The Canadian section included: C. A. McGrath, chairman, H. A. Powell, P. Mignault, Sir William Hearst and Lawrence J. Burpee. The American section included: Obadiah Gardner, chairman, R. B. Glenn, Clarence D. Clark and Whitehead Kluttz.

Kansas City Southern Case Decided in Favor of Railroad

A decision in favor of the railroad was handed down by the Supreme Court of the United States, March 8, in the Kansas City Southern R.R. mandamus proceeding to compel the Interstate Commerce Commission to admit evidence showing elements of land values not allowed by the commission. The proceedings before the Supreme Court were held Dec. 10, 1919, a report of which appeared in *Engineering News-Record* of Dec. 11-18, 1919, p. 1030.

The decision indicates that the valuations of all of the railroads may be increased. At this writing copies of the decision are not available. Some doubt is felt as to the accuracy of newspaper reports stating that the decision will compel the commission to use current prices and values in the final determination.

Railway Conference of A. A. E.

The second annual railway conference of the American Association of Engineers will be held in Chicago, March 15, for the presentation of reports of railway sections and discussion of the railway work of the association. Addresses on the classification and compensation of engineers will be given at the evening session by A. S. Tuttle, New York City; Colonel B. J. Arnold, Chicago, and O. C. Merrill, Washington. The aims and ideals of the association will be reviewed by the president, Dr. F. H. Newell.

To Co-ordinate Work of Federal Mapping Agencies

(*Washington Correspondence*)

That a milestone in governmental efficiency has been passed in the creation of the interdepartmental board of surveys and maps was the general opinion of those who gathered at the board's hearing in Washington March 9. O. C. Merrill, chairman of the board, assured the representatives of the non-federal mapping interests that the board is willing to co-operate in every way.

Judging from the developments at the Washington meeting the board will not sidestep the task of taking decisive action to co-ordinate departmental operation. The case of the non-federal agencies was presented by M. O. Leighton. The following recommendations were approved:

1. That the board of surveys and maps adopt a policy that shall direct itself exclusively to the best interests of the Government as a whole, disregarding, whenever necessary, departmental and bureau precedents, pride or authority or official prerogatives; that the mapping activities of the Government be centralized, and for the present that the U. S. Coast and Geodetic Survey continue its functions of fundamental control, while the Geological Survey or some outgrowth or reorganization thereof becomes the general and the final mapmaking agency.

2. That the board of surveys and maps formulate a consecutive plan based on the idea of centralized mapmaking activity, which shall cover the mapping work of the government and unite the organizations now constituting the board into a co-operative effort to secure Congressional approval, which plan shall provide for the completion of the standard topographic map of the United States within a specified time.

Mr. Leighton appeared for the following organizations: Engineering Council, American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Association of State Geologists, American Association of State Highway Officials, National Research Council, Association of American Geographers, American Geographical Society, Geological Society of America.

Public Roads Bureau To Classify Roads

Co-ordination of the various interested agencies is being secured by Thomas H. MacDonald, chief of the Bureau of Public Roads, in the classification of highways into systems based upon different classes of traffic; determination of the relative importance of the classes of highways as to state, county, local and national needs; the correlation and adjustment of systems between contiguous states and localities, and the distribution of the costs of

improvement of the various systems As the head of the agency that is charged with the distribution of millions of Federal funds Mr. MacDonald has long realized the need for the application of "big business" methods to his work.

Realization that not only the state and the bureau are interested in what highways are to be improved with Federal assistance, but other agencies as well, Mr. MacDonald has been holding a series of conferences with the War Plans Division of the General Staff of the War Department, with a view to determining what highways in all the states are important from a military standpoint. In addition, the bureau is co-operating with all state highway departments in road classification. Then, too, it has collaborated with the Geological Survey in the production of uniform state road maps, and several Geological Survey employees, threatened with discharge because of lack of funds, are to be transferred to the Bureau of Public Roads so that their map-making efforts may not be disturbed.

Big Lumber Association Formed

With wholesale lumber dealers in all large American cities comprising its membership, the American Lumber Association, declared to be the largest similar organization, has been formed according to its announcement issued March 6. L. Germain of Pittsburg is president.

At its headquarters in Chicago, the organization expects to begin operations the latter part of this month. Its object is stated to be the promotion of ethics, systematization of distribution, conservation of wood, but not to include price fixing.

Bonds for Chicago Public Works

A public vote on bond issues totaling $34,200,000 is to be taken at Chicago, in April, according to the plans of the council's finance committee. They include $15,000,000 for rehabilitating the lighting system, with a distribution of $3,000,000 per year for five years; $9,200,000 for ten bridges; $5,000,000 for a memorial convention hall, and $5,000,000 for parks, public playgrounds and bathing beaches.

A. A. E. Has 13,081 Members

The membership of the American Association of Engineers at the end of February was 13,081. At that time 5,635 applications for membership were pending.

Sale of Bonds Assures Road Work

Highway construction in California this year was assured by the sale, on Feb. 28, of $3,000,000 worth of the $40,000,000 highway bond issue. The bonds were sold on the market to bear interest at a little more than 5 per cent. The stated interest of the bonds is 4½ per cent, and the difference was made up by diverting certain federal appropriations to highway purposes.

Civil Service Examination

United States

For United States civil service examination, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission, for form indicated.

Assistant specification engineer, $1,200 to $2,000 per year. File application before April 14, 1920.

Inspector of structural steel erection, $8.80 per diem and higher or lower rates of pay. File application before April 6, 1920.

Junior construction engineer, $1,800 to $2,400 per year. File applicatio before March 30, 1920.

Junior designing engineer, $1,800 to $2,400 per year. File application before March 30, 1920.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 1426 Manhattan Bldg., Chicago; March 16-18, Chicago.

NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Drexel Bldg., Philadelphia; Chicago, Mar. 24, 25.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston; May 4-6; Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; 63 E. Adams St., Chicago; May 10, 11, St. Louis, Mo.

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Aug. 30-Sept. 3.

The Little Rock (Ark.) Engineers' Club has been organized with the purpose of securing more co-operation between the engineers and the board of commerce of that city. A number of committees have been appointed to give attention to important matters confronting the city, such as a solution of the problem of city lot surveying. Membership includes all engineers and architects, and the dues are $1 a year. A. M. Lund has been elected president, Fred I. Brown, vice-president and Edwin M. Williams secretary-treasurer.

The Engineers' Club of San Francisco listened to a luncheon talk by Colonel E. E. Winslow, Corps of Engineers, U. S. A., Feb. 20, whose topic was "River and Harbor Problems of the Pacific."

The Illinois Section of the American Water Works Association will hold its annual meeting Mar. 25 and 26 at Urbana. G. C. Habermeyer, Urbana, secretary.

The Colorado Association of Members, Am. Soc. C. E., will hold its 110th regular meeting at the Denver Athletic Club, Mar. 15. The meeting will be preceded by an informal dinner. Robert Follansbee, district engineer of the U. S. Geological Survey, will address the meeting on "Some Characteristics of Run-off in the Rocky Mountain Region."

The Seattle Association of Members, Am. Soc. C. E., has recently elected the following officers: President, J. L. Hall; vice-president, Major Carl B. Reeves; secretary-treasurer, Captain B. D. Dean.

The Southern California Association of Members, Am. Soc. C. E., held a special meeting, Jan. 8, in Los Angeles, which was attended by 30 members and 15 guests. Details of the new City Business Tax Ordnance were explained by City Attorney Charles S. Burnell. A communication from state water commissioner C. H. Lee, advising of proposed curtailment of funds available for the U. S. Geological Survey in California was then read, and after discussion it was ordered that vigorous action be taken to continue the work of the survey without interruption in California. Los Angeles was chosen for the 1920 convention. Major Charles T. Leeds presented a paper, "Channel Improvement as a Factor in Flood Control." A committee of five was appointed to handle all matters on city planning and to make a report at the next meeting of the association.

The Montana Irrigation and Drainage Institute was recently organized, with headquarters at Bozeman, Mont., with the following objects: "To advance knowledge pertaining to irrigation and drainage, to encourage improvement in irrigation practices, to encourage advancement in scientific and economic location, construction, operation, maintenance, and colonization of irrigated and drained lands, to promote the general welfare of settlers, to encourage scientific investigations on the better use of the state's water resources, to assist in securing adequate legislation and to encourage development of legitimate irrigation and drainage enterprises." The institute will hold annual meetings and will publish the proceedings of the meetings.

The Engineering Society of Wisconsin, at its annual meeting at Madison, Wis., Feb. 20-21, elected officers as follows: President, W. P. Hirschberg, Milwaukee; vice-president, Prof. C. I. Corp, Madison; trustees, John G. D. Mack, Madison, and F. W. Ullius, Milwaukee; secretary, Leonard S. Smith, Madison.

The Engineering Society of Western Massachusetts held a meeting, Feb. 24, at Springfield, Mass. W. E. Hodge, deputy in charge of street lighting of Springfield, gave an illustrated talk on "Street Lighting as an Engineering

Problem." John L. Harper, vice-president and chief engineer of the Niagara Falls Power Co., spoke on "Niagara Falls Power Developments," also illustrated.

The Ottawa Branch of the Engineering Institute of Canada met, Mar. 4, to hear an address on "The Development of the Canadian Mercantile Marine," delivered by Alex. Johnston, deputy minister of the Marine Department.

The Connecticut Society of Civil Engineers, at its recent annual meeting, elected the following officers: President, Thomas A. Scott, New London; first vice-president, J. Frederick Jackson, New Haven; second vice-president, Robert J. Ross, Hartford; secretary-treasurer, Henry J. Kellogg, New Haven. F. L. Ford, city engineer of New Haven, was also elected a member of the board of directors.

The Engineers' Club of Baltimore announces the following program of meetings for discussion of public improvements: Mar. 18—Harbor and Dock Development, by W. Watters Pagon, consulting engineer; Mar. 25—Extension of the Conduit System, by P. G. Ligon, chief engineer of the Electrical Commission; Apr. 1—Park Development, by Wm. S. Manning, landscape architect; Apr. 8—Health and Sanitation, by Dr. C. Hampson Jones, commissioner of health; Apr. 15—Extension of Storm Water and Sanitary Sewerage Systems, by Geo. F. Weighardt, highway engineer; Apr. 15—Extension of Street Paving System, by R. Keith Compton, chairman of Paving Commission.

PERSONAL NOTES

WILLIAM T. BARNES, M. Am. Soc. C. E., has withdrawn from the firm of Metcalf & Eddy, Consulting Engineers of Boston, to become chief engineer of the Spring Brook Water Supply Co., which supplies Wilkes-Barre, Pa., and vicinity. Mr. Barnes was graduted from the Massachusetts Institute of Technology in 1893 and after a few years on railroad work in Indiana and on water-works construction with Rice & Evans, entered the employ of Leonard Metcalf, with whom and his successor, the firm of Metcalf & Eddy, he has been ever since. In 1913 Mr. Barnes was admitted as a partner and he was for about seven years in charge of the Chicago office of the firm. In his new position Mr. Barnes will have charge of the design and construction of new works and of the technical maintenance and operation of those existing, which furnish water to a population in excess of 300,000, including besides Wilkes-Barre, the cities and towns of Pittston, Plymouth, Kingston and Nanticoke, and a number of other smaller communities.

H. A. STRINGFELLOW, assistant engineer in charge of the Detroit office for the late R. W. Pratt, consulting engineer, Cleveland, has become associated with Muller & Phipps, foreign sales agents, New York. Mr. Stringfellow will leave shortly for Asia to handle the sale of machinery and engineering supplies.

WILLIAM GOLDSMITH has resigned his position as construction engineer with the City of New York to become president and general manager of the Riverdale Construction Co. of New York City. While in the employ of the City of New York Mr. Goldsmith was charged with the layout and construction of the city's New Hampton Farms Boys' Reformatory and the Greycourt Women's Farm Colony. He was also superintendent of the Manhattan municipal asphalt plant in which position he introduced a tractor and trailer scheme of transportation which is said to have saved the city $200,000 in the first year of its operation. It is understood that it was his experiments that made possible the use of New York City sewers for the disposal of snow on the city streets in the recent snow blockade. From 1907 to 1910 Mr. Goldsmith was U. S. district engineer in the Philippine Islands. The company of which he is now directing head is doing housing development work in New York City and vicinity.

WILLIAM T. HUBER has resigned his position in charge of the western New York territory for the Portland Cement Association to enter the firm of Green & Lanctot Housewrecking Co., Inc., general contractors of Buffalo, N. Y., in the capacity of general manager and engineer. Mr. Huber, who is an associate member, American Society of Civil Engineers, served as captain in the 212th Engineers, U. S. Army.

H. E. BINGAMAN has resigned from the Pennsylvania State Highway Department to become associated with the Morgan Engineering Co. at Memphis, Tenn.

JOSEPH H. MILLER has become associated with C. E. Shearer of Memphis. The firm, under the name Shearer-Miller, will conduct a structural engineering business, with offices in the Randolph Building, that city.

P. H. FREARK, until recently in the employ of the Missouri State Highway Department, is now with the Morgan Engineering Co., Memphis, Tenn.

GANNETT, SEELYE & FLEMING, consulting engineers, Harrisburg, Pa., have opened a Southern office in the Randolph Building, Memphis, Tenn. Mr. Seelye will have charge of the office.

EUGENE B. BADINELLI, recently honorably discharged from the Corps of Engineers, U. S. A., has reentered the employ of the Morgan Engineering Co., Memphis, Tenn.

ALBERT W. DILLING, assistant engineer in the promotion bureau of the Universal Portland Cement Co., has been appointed engineering assistant to D. R. Francis, commissioner of public works, Chicago. Previous to his two years' experience with the cement company he was for 5½ years in the engineering department of the Chicago, Milwaukee & St. Paul, Ry. Co., designing, checking and detailing structures. While in railroad employ Mr. Dilling completed a law course and was admitted to the Illinois Bar in July, 1917. He has been an active member of the entertainment committee of the Western Society of Engineers, and at the recent annual elections was made chairman of the bridge and structural section.

G. P. STOWITTS, district engineer, Eastern District, New York Central & Hudson River R.R., has resigned to become chief engineer, Lord Dry Dock Co., at West New York, N. J. Mr. Stowitts graduated from Rensselaer Polytechnic Institute in 1900 and had been in the Engineering Department of the New York Central continuously since that time as draftsman, assistant supervisor on track and assistant engineer, office of engineer maintenance of way. In 1909 he became assistant designing engineer and afterwards chief draftsman in charge of general designing. Subsequently he was appointed district engineer of the Eastern District.

THOMAS C. ATWOOD, formerly district plant engineer of the Emergency Fleet Corporation for the Middle Atlantic District, has resigned to become chief engineer of the Durham (N. C.) Hosiery Mills.

COLONEL MARK L. IRELAND, of the Motor Transport Corps, U. S. A., has been appointed a member of the National Research Council's Committee on Economic Theory of Highway Improvement, of which Prof. T. R. Agg, of Iowa College, is chairman.

EUGENE I. CRANCH, city sanitary engineer of Port Arthur, Tex., has been appointed assistant engineer of the Kansas State Board of Health. Mr. Cranch graduated in sanitary engineering at the University of Michigan in 1917, and served through the war as second lieutenant in the Sanitary Corps.

G. L. CAMPBELL, formerly assistant county engineer of Saline County, Kan., has been appointed division engineer of the Kansas State Highway Commission, with headquarters at Salina, Kan.

I. E. CARMEL has been appointed superintendent of building inspection for the City of Montreal. Mr. Carmel was formerly in the employ of J. Emile Vanier. He was recently made arbitrator on the LaSalle bridge question, and also drew the plans for the St. Denis tunnel.

GUY WILFRID HAYLER, who was formerly in the service of the chief engineer of the South Park Commissioners of Chicago, and more recently engaged on city planning in San Francisco, Minneapolis and St. Paul, has

joined the staff of John Nolen, city planner, of Boston. Mr. Hayler's headquarters will be at Cambridge, Mass.

CLARENCE GOLDSMITH, who has been on the engineering staff of the National Board of Fire Underwriters in New York City for the past twelve years, and who served during the war as major in the Construction Division, U. S. Army. has been placed in charge of the recently established engineering office of the board in Chicago.

C. A. HOLMQUIST, with the Sanitary Engineering Division of the New York State Board of Health for eleven years, has been appointed principal assistant engineer of the division, to succeed H. B. Cleveland, resigned.

J. W. FRAZIER, J. W. ELLMS and R. E. SHEAL have opened offices in Cleveland, to engage in a ganeral engineering business in the design and construction of water-works, pumping and power plants, water purification and sewage disposal plants, sewer and drainage systems and buildings. The firm is also prepared to handle engineering investigations, compile reports and make appraisals.

L. P. SCOTT, division engineer of the Kansas State Highway Commission, at Salina, has been appointed division engineer for southeastern Kansas, with headquarters at Fort Scott.

V. K. WOODS, well known among contractors and engineers of the Pacific Northwest, and who has made a specialty of building logging flumes, has become assistant manager of the White Spruce Lumber Co.'s operations at Fernie, B. C. The development work of the company will require the building of a 5-mi. flume.

F. C. FREAR has been appointed county engineer of Douglas County, Ore., with offices at Roseburg. He succeeds the late M. B. Germond.

WILLIAM B. FULLER, formerly of the firm of Johnson & Fuller, consulting engineers, New York City, has joined the engineering staff of the Engineering Service Co. of Los Angeles, as hydraulic and sanitary expert.

JAMES C. BOYD, first vice-president of Westinghouse, Church, Kerr & Co., Inc., will retire April 1 to engage in private practice. Mr. Boyd has been connected with the above-named corporation for eighteen years, holding successively the positions of consulting and chief engineer and executive vice-president.

L. A. DOWNS, assistant general manager in the engineering department of the Illinois Central R.R., has been made vice-president and general manager of the Central of Georgia R.R., with offices at Savannah.

PROF. P. B. MCDONALD, assistant professor of English in the College of Engineering, New York University, has been engaged by the Western Electric Co. to give a series of twenty-four evening talks to engineers on the use of English.

CHARLES H. STEIN, recently assistant general manager of the Central R.R. of New Jersey and the Philadelphia & Reading Ry., has been appointed assistant to the president of the Central of New Jersey. Mr. Stein was born at Baltimore. His first railroad work was with the Western Maryland as rodman, and while with that road he was, successively, transitman, assistant engineer on preliminary surveys and construction, and assistant roadmaster. In 1905 he became assistant supervisor of the Philadelphia & Reading and then supervisor of that road. He entered the service of the Central of New Jersey as engineer of maintenance of way, later was appointed superintendent, and in 1918 he became assistant general manager of the Central of New Jersey and the Philadelphia & Reading.

GEORGE W. HAND, since 1918 corporate chief engineer of the Chicago & North Western Ry., has been promoted to assistant to the president, with headquarters at Chicago. Mr. Hand was born at Huntertown, Ind., in 1882. He entered the service of the Chicago & North Western in 1903 and was, successively, tapeman, rodman, instrumentman on location and construction work and on surveys, and assistant engineer on track elevation work. In 1910 he was assigned to specific investigations and state valuation work, later being appointed valuation engineer and a member of the valuation committee of that railroad and of the Chicago, St. Paul, Minneapolis & Omaha, which duties he handled until his appointment as corporate chief engineer.

J. C. PATTERSON has been promoted from principal assistant engineer of the Erie Railroad to regional engineer, New York region, with office in Jersey City. Mr. Patterson was employed as chief draftsman by the Erie in 1913, was made assistant valuation engineer in 1916 and the next year was made office engineer, which position he held until his appointment as principal assistant engineer.

OBITUARY

ALEXANDER MCCLURE LUPFER, chief engineer of the Spokane, Portland & Seattle R.R., Spokane & Inland Empire R.R. and Oregon Trunk and Oregon Electric railways, died at Portland, Ore., Feb. 3, from pneumonia. Mr. Lupfer was born in Blaine, Pa., in 1855, and graduated from Lafayette College. During his career he served as assistant engineer of the Great Northern and the Northern Pacific, with the latter on its line in Washington, including the work through Yakima Canyon; as resident engineer of the Chicago, St. Paul & Kansas City R.R.; for several years with the James J. Hill interests as reconnaisance and location engineer of the Great Northern through Washington and Montana, and from 1905 to 1911 as chief engineer of the Spokane & Inland Empire. In 1913 he was elected to the position which he held until the time of his death.

GEORGE BARKER BURBANK, civil and consulting engineer, died of pneumonia Feb. 29, at his home in New York. He was born in Kentucky 75 years ago and was a Civil War Veteran. At the close of the war he directed the building of a section of the Baltimore & Ohio R.R. in West Virginia and later handled similar work on the Denver & Rio Grande. For many years also he was interested in Alaskan railroad construction. As chief engineer of the Cataract Construction Co., Niagara Falls, he was in charge of the construction of the third power plant at the falls. He was more recently in the employ of the City of New York as an engineer on the Ashokan dam work of the Catskill water supply.

GUY CARLETON SIMPSON, a member of the consulting engineering firm of W. E. Simpson Co., of San Antonio, Tex., died in that city after a short illness, Feb. 16. He was born in San Antonio, July 10, 1885.

THOMAS H. LOOMIS, better known as "Colonel" Loomis, died at Steubenville, Ohio, Feb. 11, from heart trouble. He was born at Meriden, Conn., July 6, 1850. He was engineer of construction on the Wabash R.R. through Ohio.

CAPT. FELIX R. SMITH, a Civil War veteran, formerly assistant city engineer of Nashville, Tenn., died at the age of 82, at his home in that city, Feb. 12, from influenza.

WILLIAM VAN SCHOONHOVEN THORNE, a well known railroad director and financier of this country, died from pneumonia at his home in New York City, Feb. 6. Mr. Thorne was born at Millbrook, N. Y., in 1865. He graduated from Sheffield Scientific School in 1885, and entered the employ of the Great Northern Ry. as an assistant engineer. He became vice-president of the Erie & Wyoming Valley Ry. and later president of the Delaware Valley & Kingston Ry., from which office he resigned when those properties were bought by the Erie R.R. He was also associated with E. H. Harriman on the Southern Pacific Co., and Union Pacific System.

WILLIAM SHANNON BEATTIE, 32 years old, city engineer of Charles City, Iowa, died in that city, from influenza, Feb. 7.

JOHN W. SHEPHERD, managing engineer of the Gem Irrigation district, died at Homedale, near Caldwell, Idaho, Feb. 12, after a brief illness.

WILLIAM ARCHIBALD DUFF died in Montreal, Que., on Feb. 23 after several months illness at the age of 46. He received a science degree at McGill University in 1894, and afterwards took up post-graduate work at Columbia

University, New York City, receiving the degree of M.Sc. in 1898. After spending some years in the electrochemistry department of the Ottawa Carbide Co., he took a position with the Westinghouse Electric and Manufacturing Co. at Pittsburgh. He was subsequently placed in charge of the latter's office at Montreal, and in 1907 he was given charge of their business at Winnipeg, where he remained until compelled to retire on account of failing health.

R. L. CALDWELL, construction engineer of the Georgia Railway & Power Co., died recently at his home in Tallulah Falls, Ga., following a short illness. Mr. Caldwell had charge of the construction of the recently installed power plant at Tallulah Falls and of the reservoir below the falls. He had just entered upon the work of the Tugaloo development project of the company.

E. E. DYSARD, president of the Dysard Construction Co., Atlanta, Ga., died at his home in that city recently. For several years previous to the organization of the above named company, Mr. Dysard was superintendent of construction of the Southern Bell Telephone & Telegraph Co.

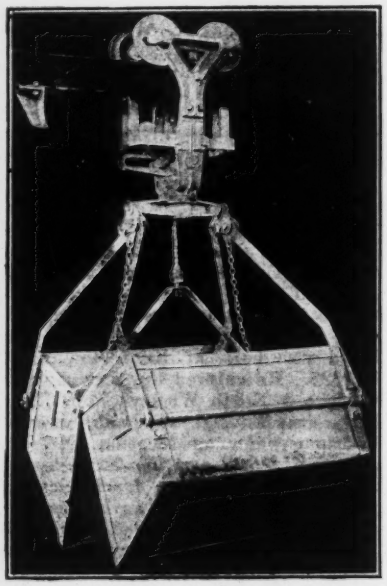
REAR-ADMIRAL ROBERT EDWIN PEARY, Arctic explorer and discoverer of the North Pole, died at his home in Washington, D. C., Feb. 20. He was born at Cresson, Penn., May 6, 1856, and was a graduate of Bowdoin College and Tufts College. He entered the United States Navy in 1881 as a civil engineer, and during 1884-5 was assistant engineer on the proposed route of the Nicaragua Canal. He began his Arctic expeditions in 1886, and in all made eight trips to the northern regions before reaching the North Pole on April 6, 1909.

HENNEN JENNINGS, noted mining engineer, died of heart disease at his home in Washington, D. C., March 5. He was born at Hawesville, Ky., in 1854. After graduation in civil engineering from the Lawrence Scientific School, Harvard University, he went West as an accountant in a California mine. He became interested in mining engineering, and quickly gained a position of eminence in that profession as the result of extensive experience in the United States, Venezuela and South Africa. He was the first president of the South African Association of Engineers and Architects. During the Pan-American Scientific Congress he was chairman of the sections of mining, metallurgy, economic geology and applied chemistry, and during the war he was attached to the Bureau of Mines as voluntary consulting engineer.

J. S. BERRY, superintendent of bridges and buildings of the St. Louis Southwestern Ry. at Tyler, Tex., died at Fort Worth, Feb. 9, from pneumonia. Mr. Berry had been in the service of the St. Louis Southwestern for more than twenty-five years.

One Trip of Paver Bucket Takes Full Batch

A new bottom dump bucket for boom and bucket distribution of concrete in paving has the combination of controlled discharge, a full swiveling motion and automatic opening and closing action. The mechanism controlling the opening and closing action is contained in the trolley frame above the



SWIVEL AUTOMATIC DUMP BUCKET FOR PAVING MIXER

swivel and out of the way of accident. Trips on the boom actuate the mechanism. Due to its full swiveling motion the bucket can be filled evenly, without pyramiding the batch, and can be discharged with the axis of the opening in any position with respect to the slab. The control chains make it possible to limit the opening so as to spread the batch or to throw it wide for quick discharge. All buckets are made to carry the full batch in one trip. They are standard equipment on the new cube paving mixer of the F. C. Austin Co., Inc., Chicago, Ill.

BUSINESS NOTES

THE BLAW-KNOX CO., Pittsburgh, and the C. D. PRUDEN CO., Baltimore, have reached an agreement for the joint operation of the two companies. Neither concern will absorb the other, it is reported. More property is to be purchased and enlargements made at the Baltimore plant, including the erection of a new standardized type of steel buildings. Albert C. Lehman, president of Blaw-Knox, is president, and Clarence D. Pruden, president of the Pruden Co., vice-president, of the new combination.

THE RANSOME CONCRETE MACHINERY CO., Dunellen, N. J., has placed its New York office in charge of Lemuel Smith, Jr., F. G. MacDonald and James H. Fitzgerald. Mr. Smith has formerly been assistant sales manager, Mr. MacDonald has been selling Ransome mixers in the New York territory and Mr. Fitzgerald has been in charge of the company's pneumatic mixer department.

TURNER CONSTRUCTION CO. has established an office in the Chamber of Commerce Building, Atlanta, Ga. R. A. Wilson, contract manager, will be in charge.

A. T. SHURICK, for several years a member of the editorial staff of *Coal Age*, from which journal he resigned to serve in the war as Captain of the 209th Engineers, and since his discharge associated with the *Coal Trade Journal*, first as editor and later business manager, has been elected vice-president of F. C. Thornley & Co., Inc., New York City. The company designs, constructs and organizes for operation installations for the mechanical handling of any material on a large or small scale. It also handles in a consulting capacity the valuation and appraisal of properties, preparation of engineering reports, etc.

THE NORWOOD ENGINEERING CO. OF CANADA, LTD., main office and factory, Florence, Mass., has recently transferred its Canadian office from Cowansville, P. Q., to 71A St. James St., Montreal. The contracting firm of Archambault & LeClair, Montreal, will hereafter represent the Norwood Co. in the Province of Quebec.

THE UNITED STATES CAST-IRON PIPE & FOUNDRY CO., Burlington, N. J., announces the opening of a new office in the Scollard Bldg., Dallas, Tex., in charge of T. W. Hanlon, southwestern sales agent.

R. G. STOWELL, formerly with the engineering department of the C., M. & St. P. Ry., has entered the employ of the Carter Bloxonend Flooring Co. and Marsh & Truman Lumber Co.'s Chicago office, as sales engineer.

WILLIAM WARING, who is in charge of the Lakewood Engineering Co.'s new Boston office, as recently announced in these columns, will direct the sales and other service of the company in its industrial products only. Waldo Bros. & Bond, Boston, will continue to handle the Lakewood construction equipment.

THE CHICAGO PNEUMATIC TOOL CO., announces the appointments of Edward A. Woodworth, formerly secretary of the Committee on Standards, U. S. Railroad Administration, and C. E. Laverenz, formerly inspector in the Ordnance Department, U. S. Navy, as special railroad representatives attached to the staff of the manager of Western railroad sales, with headquarters in the Fisher Bldg., Chicago.